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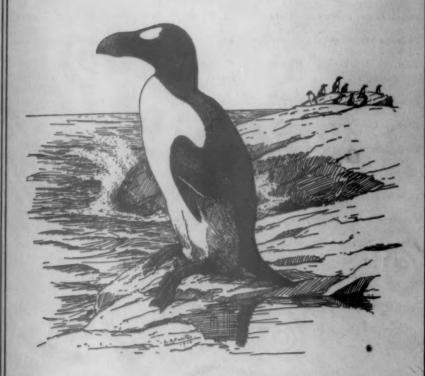
# The Auk

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NEST OF SORA RAIL. CALHOUN CO., MICHIGAN



SORA RAIL ON NEST. UPPER SOURIS, NORTH DAKOTA



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## SUMMER LIFE OF THE SORA RAIL

BY LAWRENCE H. WALKINSHAW

## Plate 3

ONE summer day when I, as a boy of fourteen, was wading through a small marshy area, I suddenly splashed into a deep muskrat run; simultaneously a bird slid off a nest and nine spotted buffy eggs very close to my bare feet and disappeared into the dense surrounding vegetation. Four days later, with an older boy, I visited the nest late in the evening and found one of the parent birds brooding several downy young. To our surprise we easily picked the bird off the nest. After we had examined its black face, brown plumage and yellowish legs for a few minutes, it suddenly gave a start and escaped, but our close examination had been enough to identify it as a Sora (Porzana carolina). Thus I met a species, which for many years has proved one of the most interesting of any that I have ever studied. The observations here recounted were made in many parts of Michigan and in Alberta and North Dakota.

#### DISTRIBUTION

The 1931 A. O. U. 'Check-list of North American Birds' gives the breeding range of the Sora as "central British Columbia, southern Mackenzie, Saskatchewan, Manitoba, the lower St. Lawrence River, New Brunswick, and Nova Scotia south to northern Lower California, Utah, Colorado, Kansas, southern Illinois, northern Missouri, southern Ohio, Pennsylvania, and Maryland." In addition, it "winters from California, Arizona, Texas, and Florida through the West Indies and Central America to Venezuela and Peru. Occasional in Labrador and Newfoundland; accidental in Bermuda, Greenland, England, Wales, and Scotland."

Most of my studies were made in Michigan and unless otherwise noted, all records refer to that State. In the Lower Peninsula of

Michigan, the Sora is the most common rail. During the months of April and May from 1934 through 1937, when a dog was used, I observed 441 rails of which 225 or 51.02% were Soras. Similarly in the Upper Peninsula during part of May 1937 and June 1934 and 1935, 136 rails were observed, of which only 24 or 17.6% were Soras.

## MIGRATIONS

The earliest date on which I ever have observed the Sora in Michigan was April 9, 1929. Mr. and Mrs. N. T. Peterson observed one at Duck Lake, Calhoun County, along a cat-tail bordered shore, on March 28, 1936. I find no earlier date. Bent (1926, p. 314) summarized the spring early dates for Michigan as: Ganges, April 5, 1893; Vicksburg, April 11, 1904; Ann Arbor, April 13, 1908; Greenville, April 16, 1896; Hillsdale, April 17, 1894; Albion, April 17, 1896; and Battle Creek, April 20, 1888. The majority of Soras arrive in Michigan during the latter part of April and the very early part of May. Following is a chart of Sora Rail migrations or early and late dates on which I have observed it:

CALHO		

Year	First	Common	Last
1919	May 18		
1920	May 10		
1922	April 16		
1923	April 28		
1924	April 27		
1925	April 19		
1929	April 9	April 9	Sept. 22
1930	May 11	May 18	Sept. 1
1931	May 16	May 16	
1932	May 1	May 8	
1933	April 30	May 11	

## CENTRAL SOUTHERN MICHIGAN (FIRST AND LAST DATES)

Year	Barry	Calhoun	Clinton	Eaton	Jackson	Kalamazoo
	County	County	County	County	County	County
1934		April 22				
1	Sept. 30	Oct. 7				
1935		April 18	May 5	May 8	April 28	May 12
	Sept. 29				Oct. 6	
1936		May 3	April 30	April 30	May 3	
-		Sept. 17			Sept. 24	
1937		April 18	April 22		May 2	April 20
	Sept. 25	Sept. 30				Oct. 17
1938	May 9	April 14	April 24		April 24	
-	Oct. 2	Oct. 2				Sept. 15

On May 6, 1937, the Sora was observed at Seney, Schoolcraft County, in the Upper Peninsula.

The latest dates of observation summarized by Bent (1926, p. 315) were as follows: "Michigan, Palmer, October 6, 1894; Detroit, October 18, 1907; Neebish Island, November 9, 1893; and Vicksburg, November 17, 1902." Wood and Tinker (1934, p. 17) gave as the latest date at Ann Arbor, Washtenaw County, October 15, 1908. Rapp (1931, p. 7) gave as his latest date at Vicksburg, Kalamazoo County, November 1, 1914.

The majority of Soras leave Michigan during the latter part of September or the very early part of October depending upon the severity of the weather. Autumns with early heavy frosts show an effect on the Soras. Where they have been common on certain areas previous to these frosts, few can be found afterward.

## NESTING

During the twenty-one years, 1918-1938 inclusive, I have found or observed 51 nests of the Sora, 48 of which were in Michigan, one in North Dakota and two in central Alberta. In Michigan the earliest date was May 2, 1937, in Jackson County, a nest containing the first egg on that date. Another nest on May 10, 1934, contained seven eggs, the first of which must have been laid on or before May 3; this was in Calhoun County. My latest date was for one found June 22, 1924, when it contained ten eggs which hatched about July 9 or 10. By far the majority of nesting dates fall during the latter part of May. In thirty-eight nests found in southern Michigan, the dates of which were known, or estimated from the date of hatching, the first egg was laid as follows: in 16 during the first ten days in May; in 16 during the second ten days; in five between May 21 and May 31; in one between June 11 and June 20. There were no later dates. In the Upper Peninsula three nests had the first eggs laid between May 21 and May 31. In McHenry County, North Dakota, one nest had the first egg laid May 24.

The average measurements of eight nests in southern Michigan were: exterior diameter, 145 mm.; interior diameter, 115 mm.; depth of nest to water level at laying time, 147 mm.; nest proper, depth, 62 mm. The water depth around the nest at laying time averaged 18 cm. This depth varied during incubation with the amount of rainfall. One nest found May 16, 1935, was completely arched over and very difficult to see. There were 10 cm. of standing water about it and the base was about 11 cm. above the water. On May 28 there was a

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3.68-inch rainfall with the result that the marshes became flooded. When I visited the region on May 30, the arched part was completely gone and the nest had been raised several cm., leaving the eggs without the least protection from above. During higher water nests might easily become flooded.

On May 12, 1935, a nest containing one egg was only barely started. On May 16, with five eggs, this nest was complete, having in addition the completed runway, a customary approach for the bird from the water level. Usually the nest, as in this case, is completed after the bird starts laying.

Nests are made of surrounding plants, usually coarser on the exterior with a finer lining of grasses or finer sedges (Carex). These usually are woven in with the immediately surrounding sedges, rushes or grasses. Unlike the Virginia Rail (Rallus limicola limicola) which may use rushes (Scirpus validus) entirely where that plant predominates, I never have noted a Sora's nest without a finer lining except when it was located in a region of coarse sedges, where a few nests had the same coarse sedges when complete. Occasionally cat-tails (Typha latifolia) were used in the foundation. In a small cat-tail marsh in Calhoun County, the Sora nests abundantly each summer. The entire central portion of the marsh consists of cat-tails while at the extreme border are sedges. Out of thirteen nests found on the area only one was located in the cat-tails; the rest were at the uniting border of sedges, built in the sedges themselves. Usually, as in other small marshes, the sedges were not thickly grouped but in clumps, containing at nesting time both old sedges and the new green stalks. Often the nests were detected at a short distance away on account of a canopy built down from the surrounding vegetation. Whereas I have seen nests in large areas of Scirpus validus, I never have found any among lily-pads in such situations as the King Rail (Rallus elegans elegans) and the Virginia Rail at times nest. Sometimes during high water the rails build in very open situations without much cover, but usually they select a marsh where the water is of a favorable depth, about six to eight inches, and sedges are the predominating plant. Many small marshes and lake borders, very favorable to the Sora, can be located each spring by driving through the country and inspecting them from the road. Sometimes a marsh may have Soras in it one year but none the following, due to a difference in water level alone.

The usual species of birds nesting near the Sora are the Virginia Rail, occasionally the King Rail, Swamp Sparrow (Melospiza georgiana), Red-wing (Agelaius phoeniceus phoeniceus), and Prairie Marsh

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Wren (Telmatodytes palustris dissaëptus). Farther west, the Yellow-headed Blackbird (Xanthocephalus xanthocephalus) and the Wilson's Phalarope (Steganopus tricolor) were found nesting in close proximity.

A list of nests found from 1918 through 1938 is summarized below:

#### NESTING DATES OF SORA RAIL

Nest No.	Date jound		Date last egg was laid	Date eggs hatched	No. of egg: in set	Locality
1	June 9, 1918	9		June 13-14 K	9	Convis Twp., Calhoun Co.
2	May 16, 1919	2	Destroyed		x	Convis Twp., Calhoun Co.
3	May 31, 1919	2	Destroyed	T	X	Convis Twp., Calhoun Co.
4	June 8, 1919	8	3.6 37	June 17-21	8	Convis Twp., Calhoun Co.
5 6	May 10, 1920	4	May 15 K	May 29-31 K	9	Bellevue, Eaton Co.
0	May 27, 1920	10		June 10-13 K	10	Bellevue, Eaton Co. Convis Twp., Calhoun Co.
7 8	May 30, 1920	10	Destroyed	June 15-15	10	Convis Twp., Calhoun Co.
	May 30, 1920 May 30, 1920	9	Destroyed		9	Convis Twp., Calhoun Co.
9		12	Unknown		12	Convis Twp., Calhoun Co.
10	May 21, 1922 May 28, 1922	5	Destroyed		x	Convis Twp., Calhoun Co.
11	June 3, 1923	7	Destroyea	June 12-15 K	7	Convis Twp., Calhoun Co.
13	June 10, 1923	7 8		June 15-19 K	8	Convis Twp., Calhoun Co.
14	June 17, 1923	6		June 20-21 K.	6	Convis Twp., Calhoun Co.
15	June 22, 1924	10		July 9-10	10	Convis Twp., Calhoun Co.
16	May 11, 1930	4	May 17 K	June 1-3 K	10	Convis Twp., Calhoun Co.
17	May 18, 1930	10		June 3-4 K	10	Convis Twp., Calhoun Co.
18	May 21, 1935	11		June 3-4 K	11	Convis Twp., Calhoun Co.
10	June 4, 1933	5b		June x-4 K	x	Convis Twp., Calhoun Co.
20	May 10, 1934	7	May 12 K	May 27-x K	9	Convis Twp., Calhoun Co.
21	May 10, 1934	2	May il K	June x-4 E	10	Convis Twp., Calhoun Co.
22	June 11, 1934	shells		Undoubtedly had hatched	X	Munuscong Bay, Chippewa Co.
15	June 14, 1984	5	Destroyed	Anna Marchica	x	Munuscong Bay, Chippewa Co.
24	May 12, 1935	1	May 19 K		8	Convis Twp., Calhoun Co.
25	May 15, 1935	6	May 20 K		11	Convis Twp., Calhoun Co.
26	May 16, 1935	5	May 21 K May 18 K		8	Convis Twp., Calhoun Co.
27	May 16, 1935			Deserted	8	Convis Twp., Calhoun Co.
20	May 16, 1935 May 16, 1935	4	May 23 K May 21 E	Unknown	11	Convis Twp., Calhoun Co.
30	May 18, 1935	3	May 22 K	Destroyed	8	Convis Twp., Calhoun Co.
31	May 19, 1935	10	May 20 K	Deserted	11	Ross Twp., Kalamazoo Co. Convis Twp., Calhoun Co.
50	May 19, 1935	3	Destroyed	27 0000 0000	×	Convis Twp., Calhoun Co.
33	May 19, 1935	2	Destroyed		X	Convis Twp., Calhoun Co.
34	May 22, 1935	7	May 25 K	June 8-9 K	10	Ross Twp., Kalamazoo Co.
35	May 22, 1935	7	May 26 K	Destroyed	11	Ross Twp., Kalamazoo Co.
36	May 26, 1935	7 8	May 26 I	Unknown	8	Convis Twp., Calhoun Co.
37	May 26, 1935	8	May #6 I	Unknown	8	Convis Twp., Calhoun Co.
58	May 30, 1935	8	May 30 I	Unknown	8	Convis Twp., Calhoun Co.
59	June 1, 1935	8	June 1 I	Unknown	8	Bath Twp., Clinton Co.
40	June 7, 1935	9	June 7 I	Unknown	9	Manistique Twp., Schoolcraft Co
41	June 7, 1985	11	June 7 I	Unknown	11	Manistique Twp., Schoolcraft Co
42	May 10, 1936	2	Deserted		x	Convis Twp., Calhoun Co.
43	June 1, 1936	8	June 6 K	Destroyed	13	Lower Souris Refuge, McHenry Co., No. Dakota
44	June 19, 1936	0	Unknown		x	Bashaw, central Alberta
45	June 19, 1936	0	Unknown		x	Bashaw, central Alberta
46	May 23, 1937	8	Unknown		8	Convis Twp., Calhoun Co.
47	May 23, 1937	8	- maile ii ii	May 27-x	8	Convis Twp., Calhoun Co.
48	May 15, 1938	8	May 17 K	June 1-5 K	10	Convis Twp., Calhoun Co.
49	May 15, 1938	9	May 15 I	May 28-June		Convis Twp., Calhoun Co.
50	May 15, 1938	7	May 15 I	Unknown	7	Convis Twp., Calhoun Co.
51	May 22, 1938	7	May 28 K	June 8-12K	12	Convis Twp., Calhoun Co.

K, known; E, estimated: I, incubating; b, broken; x, unknown. All nests in Michigan unless otherwise stated.

Nest no. 5.—The ninth and last egg was laid in this nest on May 15.

The eggs hatched May 29–31, giving the incubation period for the last egg sixteen days.

Nest no. 16.—This was found on May 11 when it contained four eggs and the female was flushed from the nest even though it was during the middle of the afternoon. This set was complete on May 17 when it contained ten eggs, and these hatched from June 1–3. The period of incubation for the last egg was seventeen days.

Nest no. 20.—When this nest was found on May 10, it contained seven eggs and one of the parents was incubating. The last egg was laid on May 12. When visited on May 27 at 10 a. m., it contained five downy young, two of which were still wet, and four eggs. Assuming that the remaining eggs hatched on May 28, at least by May 29, the incubation period of the last egg would have been either sixteen or seventeen days. Assuming that egg no. 5 was laid May 8 and hatched May 27, its incubation period would have been nineteen days.

Nest no. 28.—This was built directly underneath the nest of a Redwing. Both nests were used for some time but later the Sora deserted its nest for some reason.

Nest no. 32.—The three eggs in this nest were punctured. The openings were only a few mm. across and in one the bill which apparently had caused the puncture had pierced the opposite side. The size of the opening and the length of the bill indicated that possibly a Virginia Rail might have done it.

Nest no. 34.—When this nest was found the female was incubating seven eggs. The tenth and last egg was laid May 25, three days later. Durward L. Allen examined the nest at the close of incubation and his notes state that the eggs were present June 7. June 8, three eggs hatched. June 9, six eggs hatched. June 10, all but one egg had hatched; that one was deserted. The mark on this egg was obliterated, consequently the incubation period would be about sixteen days.

Nest.no. 43.—This nest, in the Lower Souris Refuge of the U. S Biological Survey, was built on an area flooded that spring where there had been no standing water for a number of years. It was built of stalks of Iva xanthifolia, a tall rank growth on the area, and was lined with finer grasses. It was in the open without protection. Something destroyed the eggs late during the incubation period.

Nests no. 44 and 45.—A Sora was flushed from each of these completed yet empty nests, the day they were found but I did not revisit them.

Nest no. 48.—The female was incubating eight eggs on May 15 when this nest was found. The tenth and last egg was laid on May 17. On June 1 at 6 a. m., it contained six young and four eggs; on June 2, seven young; on June 3, all eggs were hatched by 6 a. m. but nos. 9 and 10;

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On en o; on June 4, egg no. 9 hatched. Egg no. 10 hatched June 5, late during the day. On June 6, the female was brooding several young early in the morning and on June 7 had evidently just left the nest when I arrived at 6 a. m. She was scolding a bittern in that vicinity but the nest was warm and dry even though there were no young in it by the time I reached it. The incubation period for both eggs nos. 9 and 10 was nineteen days. Even egg no. 6 had an incubation period of nineteen days. The weights of several young and of the eggs from which they hatched were taken at this nest and are as follows:

No. of	Wt. of eggs	Wt. of eggs	Wt. of young the
egg	May 16-18	June 1-3	day of hatching
7	8.7 grams	7.7 grams	6.3 grams
8	8.5 grams	7.8 grams	6.3 grams
9	8.6 grams	7.8 grams	6.4 grams
10	7.9 grams	7.4 grams	6.0 grams

Nest no. 49.—The last egg hatched in this nest seventeen days after it was found, when it contained a full complement of eggs. Egg no. 1 weighed on May 26 when pipped, 8.6 grams. On May 28 at 5 a. m., the young from it weighed 6.6 grams. Similarly eggs nos. 4 and 5 weighed 8.9 grams and the young 7.5 and 7.3 grams respectively. Egg no. 8 weighed 8.8 grams, from which a young hatched weighing at hatching 7.1 grams.

Nest no. 51.—Mr. N. T. Peterson found this nest while we were visiting the same small marsh containing nests nos. 48 and 49. It contained seven eggs, cold. On May 23, it contained eight eggs at 5.30 a. m.; May 24, the same; May 25, nine eggs; May 26, ten eggs; May 27, eleven and May 28, twelve eggs. Incubation started May 23. June 8 the nest contained five pipped eggs; June 9, at 5.30 a. m., five newly hatched young and seven eggs, embryo dead in another egg; June 10, six young hatched; June 11, at 5.30 a. m., seven young; June 12, no additional young; June 13, nest and eggs deserted, one embryo nearly out, dead, and three other unhatched eggs, nos. 10, 11 and 12. Incubation period of first five eggs seventeen days; sixth egg eighteen days; eighth egg, marked when laid, nineteen days. The weights of eggs and young are summarized as follows:

			•
No. of egg	Wt. of egg May 23	Wt. of egg June 8_10	Wt. of young June 9-11
1	7.3 grams	6.8 grams	5.8 grams
2	7.3 grams	6.7 grams	5.8 grams
3	7.6 grams	6.9 grams	5.8 grams
5	7.5 grams	6.7 grams	5.3 grams
6	6.5 grams	5.5 grams	5.0 grams
7	6.9 grams	5.8 grams	5.0 grams
8	7.1 grams	6.6 grams	5.8 grams

#### THE EGGS

The eggs of the Sora are darker buff and the spots are usually larger with more even outlines than those of the Virginia Rail. Bent (1926, p. 305) says of the color: "The ground color is a rich buff, varying from 'chamois' or 'cinnamon buff' to 'cream buff,' 'ivory yellow,' or even 'pale olive buff.' They are irregularly spotted with browns and drabs, 'auburn,' 'chestnut brown,' 'russet,' 'snuff brown' and shades of 'cinnamon-drab' and 'ecru drab'."

Out of 39 nests containing full complements of eggs, the number varied from six to thirteen, with an average of 9.35 eggs per set. The complete list is as follows:

No. of eggs per set	6	7	8	9	10	11	12	13
No. of sets	1	9	19	6	8	6		,

All of these except the thirteen-egg set, which was in North Dakota, were in Michigan.

The 128 eggs in sixteen nests were weighed when newly laid; they averaged per set: 8.99, 7.21, 9.56, 8.96, 9.66, 8.5, 8.2, 7.86, 8.4, 8.09, 9.1, 8.2, 8.8, 9.15, 8.39 and 7.28 grams respectively. The average of the 128 eggs was 8.36 grams. The lightest egg weighed 6.5 grams and belonged to a set of twelve eggs averaging 7.28 grams. Another egg weighed only 6.9 grams and belonged to a set of eleven eggs averaging 7.21 grams. The heaviest egg weighed when fresh 10.25 grams. Measurements of 129 eggs averaged 31.503 x 22.8 mm. The largest egg measured 36 x 25 mm., the smallest 28.5 x 20.9 mm., and another 29 x 20 mm.

One egg was laid each day during the very early hours of daylight except on rare occasions where a day was skipped. Incubation usually began several days before the last egg was laid with the result that the eggs hatched over a period of several days.

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## THE YOUNG

The incubation periods at the six nests as recorded above were 16 days, 17 days, 16 possibly some to 19 days, 15 or 16 days, 19 days and 17 to 19 days respectively. The eggs always hatched over a period of days, from two or three to four, five, and possibly more. Three of these periods have been previously published (Walkinshaw, 1935, pp. 79–80). Bent states (1926, p. 305), that "the period of incubation is said to be 14 days," and 14 days was the period given by Mousley (1937, p. 81) at one nest. Of the six nests I would state the incubation period of the Sora was from 16 to 19 days in Michigan.

The eggs are pipped from 24 to 48 hours before hatching. The young after emerging, are covered with black glossy down varying from 5 to 15 mm. in length, longer on the back of the neck. At the base of the lower mandible are a number of orange 'bristles' and at the base of the maxilla is a little red protuberance about 1 mm. in diameter. The bill is bluish gray, tipped with a tinge of yellow and has the prominently white egg-tooth near its tip. The legs and feet are very light gray with a bluish undertone. About 8 mm. from the tip of the second digit of the wing is a short claw about 1 mm. long.

The downy young of the Sora are able to leave the nest as soon as the down is dry, sometimes sooner if danger threatens. Usually when a nest was approached during hatching time, all of the hatched young were underneath the incubating parent and clambered over the edge into the water when the bird left. At other times from a blind, I have watched the young congregate about one of the parents a short distance from the nest while the other parent incubated the remaining eggs. Twice I have watched the adult brood newly hatched young right in the water, which in both cases was about six inches deep. The feathers of the breast were all fluffed down to the water's surface as the young clambered underneath. Both parents have been noted incubating the eggs, for I have watched them change places at the nest.

A number of downy young have been weighed and measured. Following is a summary of these, showing the increase in weight of the older young, which often remained at the nest with the incubating parent:

Age	Wt. in grams	Wing in mm.	Tarsus in mm.	Culmen including red protuberance in mm.	No. of young
hatched	6.35	12.37	12.1	7.0	21
1 day	7.91	13.0	12.66	7.0	8
2 days	10.53	14.66	12.66	7.6	3

The variation in weight among the twenty-one young at hatching was 5.0 to 7.5 grams; at one day of age, from 5.8 to 8.8 grams; at two days, 9.9 to 11.1 grams. The wing was measured with a straight-edge ruler.

At some nests I have found a parent brooding the young during the early morning a day or two after they had hatched; at other nests I have found no signs of parents or young even the day following that on which the last young hatched. Evidently the parent broods them wherever they find it most suitable, but if night finds them near the nest, they return to it. I have never observed the families of young on high land areas near the hatching marsh as I have in the case of the Virginia Rail. During the summer of 1938, at one small marsh three broods of young Soras hatched late in May and early in June. I had erected a V-shaped chicken-wire approach to a funnel trap at one end of the marsh. On July 17, nine of us made a drive, without success. One young Virginia Rail a month old was captured, but no Soras, even after a second drive using a dog. Evidently the young Soras, five or six weeks old, had left the marsh overland to some other area. This has proved to be the case in most of these small marshes examined a few weeks after the breeding season.

During August and September, and often during the earlier part of October, many Soras can be found on boggy areas where wild rice (Zizania) is the predominating plant. Birds flock here by the dozens, and the marshes ring with their voices when one throws a stone into the water. Stomachs examined, of birds from these areas, show that they feed mostly on the seeds of the rice. A number of Soras have been observed along sedge-bordered lakes during late summer, where the actual water borders were boggy, with loosestrife (Decodon verticillatus) forming a shady dense shore-line.

Summarizing: Soras during early spring and the nesting period spend the time in small grass- and sedge-grown swales, ponds, and lake borders, retiring to the lake shore-lines, and rice-covered marshes in late summer where they feed until migration time.

#### VOICE

During the days of spring, when the ponds ring with the voices of frogs, often from the same location the 'whinny' of the Sora can be heard, whee-hee-hee-hee-hee-hee, increasing in rapidity as it is given. Again, at this season, a note is heard which also has been traced to this same species, a plaintive ter-ee. Although I have heard the whinny

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of be en. to at times in late September, spring is the only season during which I have heard this latter call.

Often when disturbed at the nest the birds gave a sharp quink-quink-quink. Sometimes a sharp kuk-kuk is given. Later in the summer when a stone was thrown into the water where the Soras were congregated, a piping queep was the resulting cry, or often a three-syllabled note described by W. Leon Dawson (1923, p. 1542): "Often and often have I flung a stone or a stick of wood into a wayside clump of tules to be rewarded instantly with a shouted 'crick creek croo,' satisfying evidence that the Sora is on the job."

The downy young often gave a low queea changing to a much shriller queee when they were in trouble or danger.

## WEIGHTS

The weights of the downy young taken at four different nests are given above. The young of each definite brood weighed about the same at the same age, but often those of another nest varied as much as 2 grams. The lightest weight recorded for newly hatched young was 5.0 grams.

At one day of age the weight of eight individuals varied from 5.8 to 8.8 grams and on the second day three individuals ranged from 9.9 to 11.1 grams.

Esten (1931, p. 573) recorded some weights of Soras taken by Wm. Van Gorder without any sex differentiation, as follows: "April 24, 1911, two, 76 and 106 grams. April 9, 1915, 51 grams (very poor). May 3, 1911, two, 61.5 and 83.5 grams. April 27, 1916, two, 125.7 and 111.7 grams."

A number of specimens collected in southern Michigan have been weighed. Most of these are in the University of Michigan Museum of Zoology, with the kind permission of which the following weights are given:

		ADULT MALES	3	
Museum number	Where collected	By whom collected	Date taken	Weight
95930 66001 83652	Washtenaw Co. Mackinac Co. Jackson Co. Barry Co.	J. Van Tyne J. Van Tyne P. Brodkorb J. Kendrick	May 3, 1938 Sept. 4, 1930 Sept. 13, 1936 Oct. 2, 1938	91.5 grams 83.0 grams 71.7 grams 105.6 grams
Average o	of a adult males			87.05 grams

101	WALKINS	April		
		IMMATURE MAI	LES	
96399	Washtenaw Co.	L. D. Case	July 31, 1938	73-5 grams
72285	Jackson Co.	J. Wood	Aug. 4, 1933	89.5 grams
91544	Jackson Co.	A. Staebler	Aug. 29, 1937	84.0 grams
	Barry Co.	H. Bradley	Oct. 2, 1938	73.4 grams
Average of	4 immature males			80.1 grams
Average of	8 males			84.0 grams
		ADULT FEMALE	ZS .	
C. J. H. 23	Clinton Co.	C. J. Henry	May 5, 1935	78.2 grams
91952	Calhoun Co.	L. H. W.	Aug. 12, 1934	65.0 grams
69175	Washtenaw Co.	J. Van Tyne	Aug. 13, 1932	72.5 grams
Average of	3 adult females			71.9 grams
		IMMATURE FEMA	ALE	
86413	Jackson Co.	R. E. Olsen	Sept. 8, 1935	75.2 grams
Average of	4 females			72.72 grams

The average of the nineteen birds recorded above is 83.0 grams. One notes that although there is some overlapping in the weights of the sexes, the males average considerably higher than the females. This also is the case in both the Virginia and the Yellow Rails (Coturnicops noveboracensis) as recorded by the author (1937, 1939).

#### SURVIVAL

If one considers that no marked increase or decrease from year to year is noted among the average species of birds, he realizes that there must be some ratio between the survival of hatched young, the number of eggs hatching, the number of broods raised and the average length of life of individuals of that species. Soras probably raise only one brood annually but the size of broods at hatching time is large, six to thirteen, yet there is no appreciable change from year to year in their numbers so that the majority of hatched young probably never become breeding birds.

Out of 36 nests, the outcome of which was known, 22 brought off young, a percentage of 61.11. In these 36 nests, 266 eggs were laid of which 177 hatched, giving a percentage of 66.54, somewhat higher than the usual average for passerine birds, where the young remain in the nest for a period of days (Nice, 1937, pp. 143, 180–189). The number of young, 177, considering them as all hatching in one year, plus their parents, 72 birds, would become 72, plus or minus, by the following spring. In other words around 177 young and adults would be killed from the original 249 birds.

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Probably the elements, rain producing flooded conditions, drouth, extreme cold and heat, produce a large percentage of the casualties. Again, the water of the marsh prevents many predators from troubling the rails but I have seen raccoons (*Procyon lotor lotor*) on these rail marshes even during the daytime. When the young feed near the shore they are certain to be captured at times by some of the dry-land predatory mammals. The downy young although good swimmers and hiders, are slow and easily caught. However, they always try to get away from the danger, then hide deep within some clump of grass or sedge, and do not reappear until their parent calls them out.

At several different places I have found the remains of Soras on posts in these marshes where some hawk or owl had fed on them. Marsh Hawks (Circus hudsonius) and Short-eared Owls (Asio flammeus flammeus) have been observed coursing repeatedly over rail-inhabited areas, and I have found Yellow Rail feathers in Short-eared Owl pellets. Since the Marsh Hawk is the most abundant and I have found both Yellow and Sora Rail remains where there were no Short-eared Owls at that time, it is my belief that these hawks capture a few rails.

## BEHAVIOR

The Sora, like other rails, is very hard to flush from the reeds which it inhabits, yet I believe it will fly more readily than either the Virginia or the Yellow Rails. When flushed, it usually flies farther and faster than those species. With the exception of the bird caught when I was a boy, I have never caught a Sora, even with the help of a dog. They always depend on their wings and legs for escape rather than hiding. If they did hide, when the dog approached, they immediately flew, giving him no chance to capture them. At all seasons, even during winter in central Florida, I have found the Sora a lover of areas covered with a shallow depth of six to eight inches of water, usually where a food supply was abundant.

If one wishes to observe the behavior of Soras in their native habitat the best way is to remain motionless either in a blind or resting on some solid object in or near their habitat. One is certain to observe them working back and forth feeding from the surface of the water. Yet, if one makes a single movement they will quickly disappear. They are very curious though and will return to investigate the cause of the movement.

I have spent ten to twelve hours in blinds at Soras' nests. There is always a marked difference in the behavior of individual birds but the Sora is a wilder bird at the blind than the Virginia Rail. Some birds will spend hours away from the nest before returning while others will return almost immediately. At one nest, on May 27, 1934, where I was attempting to photograph the adults, I had captured and placed in my hat within the blind, five downy young, hoping that the parent might return quicker to the eggs. After waiting two hours without success, although both parents were walking through the sedges very close to the blind and the young were occasionally peeping from inside, I released them, one at a time, with the result that one parent assembled them a short distance from me while the other returned to the edge of the nest, but would not incubate the eggs while I was there; so I finally left. A similar observation was made at a nest on May 27, 1937, but both adults incubated the eggs during the period of two hours which I spent there and when the young were finally released one parent brooded them a few feet from the nest right in the water while the mate incubated the remaining eggs. When I left the blind, both birds quickly left the area, skulking amongst the neighboring vegetation while the young scattered to the nearest clumps of sedges to hide.

The birds, in nearly all cases, even if afraid of the blind, entered their nests by the built-up slanting runways. Sometimes if their fear was too much they would squeeze through the sedges at the back of the nest rather than approach to the runway at the front.

#### SUMMARY

The Sora Rail is a summer resident over the entire State of Michigan, much more common in the Lower Peninsula than in the Upper. The first birds of the year have been observed as early as March 28, often early in April, but usually the main migration appears in late April or very early in May. Nesting starts during the early part of May, the earliest date for southern Michigan being May 2. Thirty-seven out of thirty-eight nests had the first egg laid in May and thirty-two of these during the first twenty days of that month. In north-central North Dakota, one nest had the first egg laid May 24. The nests were built in sedges or rushes over about 18 cm. of standing water; often the first eggs were laid before the nest was completed. The young hatched during late May or early June.

From six to thirteen eggs are laid, averaging for 39 nests, 9.35 eggs

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per set. The average weight of 128 eggs was 8.36 grams when fresh. The extremes were 6.5 grams and 10.25 grams. The average measurements of 129 eggs are 31.503 x 22.8 mm., varying from 29 x 20 mm. to 36 x 25 mm. The color was buffy with fairly large brownish spots. These eggs were deposited during the very early hours of morning, usually one each day until the set was complete.

The incubation periods at six nests varied from sixteen to nineteen days. The young were covered with glossy, black down and had orange bristles at the chin and a red protuberance at the base of the maxilla. They averaged in weight (21 individuals) 6.35 grams at hatching time, then 7.91 grams (eight individuals) the next day, and 10.53 grams (three individuals) the second day after hatching. They often left the nest immediately but occasionally remained at least the two days after hatching.

The so-called 'whinny' is the outstanding call of the Sora.

The average weight of twelve individuals was 81.9 grams, that of four adult males 87.95 grams; of four immature males, 80.1 grams (the eight males averaged 84.0 grams). The average weight of three adult females was 71.9 grams and of one immature, 75.2 grams and for the four females 72.72 grams.

Out of 36 nests, in which 266 eggs were laid, 177 young were brought off from 22 nests, giving a success percentage for nests of 61.11 and for eggs of 66.54.

In late summer the Sora retreats to areas where food is more plentiful. Wild-rice beds have been found to be favorite feeding areas until the rails depart for the south late in September or early in October.

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## COURTSHIP FEEDING IN BIRDS

## BY DAVID LACK

#### INTRODUCTION

In many different groups of birds the male feeds the female during courtship or incubation. The literature on this point is large and scattered. The object of the present paper is to summarize the data so far as I have been able to collect them. So many instances have been reported in works dealing primarily with other matters that I cannot hope that the present list of birds is nearly complete. Indeed, one of the objects of this paper is to stimulate others to record instances from types of birds not recorded here. Some years ago correspondents of 'The Auk' greatly increased our knowledge of the extent of 'injury-feigning' in birds and in this, as in courtship feeding, an accurate knowledge of all those groups in which it occurs, and also of those in which it does not occur, greatly assists in interpreting the significance of the habit. Before publication, I am sending this paper to Mrs. Margaret M. Nice with the request to add all the cases that she may know from her unrivaled knowledge of the literature of bird courtship. Indeed, should the European situation make it impossible for me to see the proofs of the paper, I am asking Mrs. Nice to supervise publication. I must also thank Dr. E. Mayr and Dr. G. K. Noble for their help in discussion.

#### MANNER OF FEEDING

In most cases of courtship feeding, the female adopts an attitude and calls almost identical with those of a young bird begging food from its parents, and the male puts food into the female's mouth.¹ In some birds, the male simply collects the food in his beak and then presents it to the female; in others, notably in some Fringillidae (i. e. Carduelinae) and gulls, the male regurgitates the food to the female, as he also does when feeding the young. While this is the normal procedure there are a few variations. Thus in the Herring Gull and other gulls, the male regurgitates the food on to the ground in front of the female, and the female then swallows it. In terns, presentation of food is often preceded by a ceremonial flight. In some birds of prey,

<sup>&</sup>lt;sup>1</sup> Monika Holzapfel in her 'Analyse des Sperrens, und pickens in der Entwicklung des Stars' (Journ. f. Ornith., 87: 525-553, 1939) suggests that 'gaping' for food is not merely a juvenal phenomenon, but that it is replaced by the tendency to peck for food, and becomes latent, reappearing later in those species where the male feeds his mate.—M. M. N.

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notably Circus, the food is passed from the male to the female in the air, the female turning over to catch it. In the Adélie Penguin (Pygoscelis adeliae) the male brings not food but snow to the incubating female. Dr. Mayr draws my attention to Gallus gallus domesticus, which does not present the female with food, but scratches the ground up for her (as a hen does for her chicks).

## THE RÔLES OF THE SEXES

In nearly all birds it is the male which feeds the female. The respective rôles of the two sexes are almost as constant as are the positions adopted in copulation. A partial exception is the waxwing (Bombycilla), in which male and female exchange food backward and forward, but it is again the male which first presents and the female which first receives the food. I once observed the same in Platyspiza crassirostris, one of the Galapagos finches, but here it is very unusual, and I have seen it once (out of hundreds of cases) in the British Robin (Erithacus rubecula melophilus), when the birds were disturbed by a mount near the nest.

In one bird, the Button Quail, Turnix, the normal procedure is reversed and the female feeds the male. This was perhaps to be expected, since in Turnix nearly all the sex behavior is reversed. In Common Terns (Sterna hirundo), Tinbergen records that, in the early stages, either sex may beg for or present food. Under artificial conditions in captivity, I have had a female British Robin feed another female, and a male beg food from a female.

Why, normally, the male should give the food and the female receive it, and not the reverse, is far from clear. The occurrence of the opposite in *Turnix*, where other sex behavior is also reversed, is confirmation that there is a fundamental distinction between male and female in this matter. Possibly it is related in some way to the phenomena classified under the term 'dominance,' but I am not too happy as regards the use of this latter term owing to its subjective implications. The captivity records of the British Robin show that the behavior normally found in one sex is latent in the opposite sex (this seems to apply to all phases of sexual behavior in birds).

#### SIGNIFICANCE OF THE FEEDING

In many species in which courtship feeding occurs, the male also feeds the female on or near the nest during incubation. Hence, at this stage of the breeding cycle, the food may have real significance.

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also e, at ance. Indeed, there probably exist species in which the feeding habit is restricted to the incubation period. In this case, it could not be classed as courtship feeding at all. I know of no fully established cases, but this may well occur in some of the species given in the table later in which there are records of feeding only during incubation, e. g., some titmice (Paridae), some finches (Fringillidae), some crows (Corvidae). However, there are also some species, e. g., Aix sponsa, Gallus and Turnix (? also Centropus and Coccyzus) in which the feeding of the female by the male occurs in courtship but apparently ceases before incubation. Further, in many of the species in which the male feeds the female during incubation, feeding is also regular before incubation and in some species, e. g., the British Robin, it is much commoner before than during incubation. Hence, in these latter birds the main function of courtship feeding is clearly display.

Clearly the primary object of courtship feeding is not the food which is passed. Numerous cases could be cited to show this. I may quote Goethe (1937), that a female Herring Gull (Larus argentatus) just returned from feeding on the shore, and, therefore, presumably well fed, may beg her mate for food although he has remained near the nest and has not fed recently. Again, in captivity a female British Robin would often beg her mate to feed her though she was standing on the food tray, surrounded by live mealworms, and he was some distance away. Again, in Bombycilla, the food is passed back and forth between the sexes and finally is often eaten by the male.

In some species, courtship feeding seems closely associated with copulation. Thus, in Centropus javanicus the male holds an insect in its beak during copulation and feeds the female immediately afterward. In the Yellow-billed Cuckoo (Coccyzus americanus), the male also held an insect during copulation, and, toward the end, the female slowly turned her head and took and ate it. In Camarhynchus parvulus, one of the Galapagos finches, Mr. W. H. Thompson saw the male feed the female during copulation. Again, in the Herring Gull, Goethe records that the initiatory stages of copulation are closely similar to those of the male feeding the female. In Columba livia, the male feeds the female before copulation. In the European Nuthatch (Sitta europaea), courtship feeding and copulation are also said to be correlated, and this may be the case in Gallus gallus domesticus.

The association of courtship feeding with copulation in the above species seems clear, and this applies to some other species. However,

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there are other birds in which there is no connection between courtship feeding and copulation. This is clearly the case in the British Robin, in which courtship feeding and copulation occur quite independently, and whereas copulation is restricted to a very limited period during nest building and egg laying, courtship feeding occurs throughout the breeding cycle except when the birds are feeding the young. This was also true for the Galapagos finches except for the one case in *Gamarhynchus parvulus*, already reported (D. Lack and W. H. Thompson); it applied to *Spinus lawrencei* (D. Lack) and evidently applies to many other species, since the observers make no records of any connection with copulation. Further data are desirable but it seems probable there are more species in which the habit is not connected with copulation, than those in which it is.

The function of courtship feeding in the latter forms is presumably to maintain the bond between the pair, which is especially important in birds in which both sexes feed the young. In this connection it seems significant that courtship feeding is found mainly in birds in which both sexes care for the young. This is especially significant in those groups of birds which include both some species which remain paired, and some which do not form a pair bond. Thus, in the gallinaceous birds, the Bob-white (Colinus virginianus) remains paired and courtship feeding occurs, whereas it does not occur in the many gallinaceous birds where no pair bond is formed. Again, in the cuckoos (Cuculidae), it occurs in Centropus and Coccyzus, but not (so far as known) in the parasitic forms. There are, however, exceptions to this rule. Thus in Turnix, the female leaves the male soon after incubation has commenced.

## OTHER FEEDING HABITS

This habit of one bird feeding another seems normally part of courtship. However, two cases are reported by Murphy in which a Fregata magnificens and an adult Brown Booby (Sula leucogaster) at least four years old, were found in perfect condition at breeding colonies, although each possessed only one wing and could never have captured food for itself. Both birds apparently retained the food-begging behavior of the young and were maintained by other members of the colony.

That the begging of food by a young bird exercises a strong attraction on adults is also illustrated by the not infrequent occasions on which passing birds have fed a fledgling European Cuckoo (Cuculus uk

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canorus) or Cowbird (Molothrus ater) reared by other foster parents. Possibly parallel are the cases reported by Skutch of individuals helping to feed a brood of young. In European Swallows (Hirundo rustica), the Moorhen, (Gallinula chloropus) and the Bluebird (Sialia) (see Laskey, Bird-banding, 6: 23–32, 1939), the young of the first brood may even help to feed the second brood.

The occurrences of these instances divorced from any courtship display make it easier to understand how the feeding habit could have become incorporated into display.

## SYMBOLIC NATURE OF THE HABIT

Since the main function of courtship feeding is not food, it might be classified as a type of 'symbolic' display, i. e., in which an act normally playing some other part in bird behavior is introduced into display. Habit preening, and the manipulation of nest material are other examples. In many species (but certainly not all, Wood Duck (Aix sponsa), and Turnix are presumably exceptions and so probably are those species where courtship feeding occurs primarily in connection with copulation) feeding may have been introduced into the sexual cycle through an extension back into an earlier phase of the cycle of the habit of feeding the female during incubation. In this it closely parallels the 'display building' of the Galapagos finches and other birds, in which building and manipulation of nest material are a prominent feature of courtship, but the eventual functional nest is often built at a later stage. In birds, many instinctive acts are exhibited in a partially developed form before the biologically 'correct' moment arises, and this phenomenon would supply the initial element on which selection could later work.

In some cases, courtship feeding is reduced to an incipient act. Thus, billing occurs in the Mourning Dove (Zenaidura macroura), the European Kingfisher (Alcedo atthis), the Rook (Corvus frugilegus), the Chough (Pyrrhocorax pyrrhocorax), the Waxwing (Bombycilla), and some Fringillidae, e. g., Hawfinch (Coccothraustes), the Siskin (Carduelis spinus), Geospiza, and other species; also in Peregrine Falcons (Falco peregrinus), which touch beaks in the air. In these birds billing can be regarded as incipient courtship feeding. It should be noted that in some other birds, e. g., herons, billing has probably not developed from courtship feeding but possibly from the passing of nest material from the male to the female. In yet others, e. g.,

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Fulmar (Fulmarus glacialis), billing has clearly originated from neither of these acts.

The 'fish flights' of terns may also occur without any exchange of food. This habit, like billing, may, therefore, be regarded as symbolic of courtship feeding, which is itself a symbolic act. In the Black Skimmer (Rynchops nigra), Pettingill has recorded a male presenting the female with driftwood instead of the usual food (presumably because the male had no food available at the time).

## OCCURRENCE OF COURTSHIP FEEDING

So far as is known, birds are the only vertebrates which exhibit courtship feeding (omitting the sporadic occurrences in human beings). However, it rather surprisingly occurs in one other group of animals, namely, the dipterous flies of the family Empidae. In the latter, it seems associated with inducing the female to copulate and, interestingly enough, in some species the courtship feeding is symbolic in that no real food is passed but various substitute objects are used (O. W. Richards, Biol. Rev. Cambridge Phil. Soc., 2: 298–360, 1927).

Courtship feeding occurs in so many widely separated groups of birds that it has almost certainly originated several times independently. Particularly striking in this respect is its occurrence in one species of duck, in just a few gallinaceous birds, in one species of wading bird, and in Tropic-birds but no other Pelecaniformes. There are also species, e. g., Chiffchaff, Wood Warbler (Phylloscopus spp.), Tree Pipit (Anthus trivialis) and Bluebird (Sialia sialis) in which the habit is only rarely found and in which many individuals apparently do not show it.

Further, the survey, given below, of the species in which male feeding female occurs, shows that it plays a rather different part in the lives of different species and may have originated in different ways. Thus, in some species it occurs primarily (possibly exclusively) during incubation. In other species it is regular during incubation but commoner before it. I had thought at first that the habit might be restricted to birds in which only the female incubates, e. g., many finches, titmice, crows, and others. Further study shows that this is by no means the case. Prominent exceptions are the gulls (Larus), terns (Sterna), pigeons (Columbidae) and others. There are even species in which courtship feeding occurs although one sex leaves the other at incubation. Further, many passerine groups in which only the female incubates do not exhibit courtship feeding. Again, there are

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species in which the habit seems closely linked with copulation, and others in which it has no connection with this. In Red-backed Shrike (Lanius collurio) it seems correlated with both copulation and incubation. All these points should be borne in mind by future observers.

In the following list it is seen that courtship feeding is sometimes typical of a whole family of birds, while in others only one or two genera in a family may show it. (I know of no cases where two species of the same genus differ.)

In the following list I follow the order and classification of bird families proposed by Wetmore (1934) and record those forms in which courtship feeding has been found, and also those forms which have been studied sufficiently for one to be fairly certain that the habit does not occur. If the word 'incubation' is written after the species, it means that the habit has as yet been recorded only during incubation. This should not be taken to mean that the habit is confined to incubation, as courtship habits have been studied much less than nesting habits. I have omitted altogether certain tropical families about which nothing is known, and have been unable to cover the Australian and New Zealand literature. I hope some reader of 'The Auk' may be able to do this.

## CLASSIFIED LIST

- PALAEOGNATHAE (struthious birds). Apparently absent.
- SPHENISCIFORMES (penguins). Adélie Penguin (incubation) brings snow.
- GAVIIFORMES (loons). Absent.
- COLYMBIFORMES (grebes). Absent.
- PROCELLARIIFORMES (petrels, etc.). Absent so far as known; certainly absent in Fulmarus.
- Pelecaniformes (tropic-birds, pelicans, frigate-birds, cormorants, boobies). Found only in tropic-birds.
- CICONIIFORMES (herons, etc.). Absent.
- Anseriformes (geese, ducks, swans). Normally absent; occurs in Aix sponsa.
- FALCONIFORMES (birds of prey). Regular in Circus (correlated with a special flight, the 'pass') and Falco spp., e. g. peregrinus, subbuteo, sparverius, aesalon; also recorded in Accipiter nisus, Milvus migrans, Haliaeetus albicilla, and (unusually) Aquila chrysäetos. In most of the above, it has been recorded only during incubation, but definitely earlier in Falco peregrinus, F. sparverius, F. columbarius aesalon, and Circus pygargus.
- GALLIFORMES (gallinaceous birds). Normally absent, regular in Colinus virginianus; occurs in Gallus gallus domesticus.
- GRUIFORMES (cranes, rails, etc.). Regular in Turnicidae (button-quails), where female feeds male. Recorded during incubation in Rallus aquaticus, and by one observer in Gallinula chloropus; possibly not regular in the last, since it is not mentioned by most observers.

CHARADRIIFORMES (a) Charadrii (shorebirds). Normally absent, but recorded in Burhinus oedicnemus (Stone Curlew). (b) Lari. In the Laridae, regular in all species of Larus (gulls) and Sterna (terns) so far studied, in the former by regurgitation, in the latter associated with a 'fish flight.' Recorded in Rynchops nigra (Black Skimmer), but apparently absent in the third family of the Lari, the Stercorariidae (skuas, jaegers). (c) Alcae (auks). Apparently absent.

COLUMBIFORMES (pigeons, doves, etc.). Regular, by regurgitation, in Zenaidura, Columba, Ectopistes, Turtur, and presumably other genera of the Columbidae.

PSITTACIFORMES (parrots). Recorded in captive Psephotus and Platycercus. Mr. Karl Plath of the Brookfield Zoo informs us that this is regular in all parrots; in homosexual pairs it may be exhibited by females.

CUCULIFORMES (cuckoos, etc.). Recorded in Centropus and Coccyzus; apparently absent in parasitic forms.

STRIGIFORMES (owls). Recorded in a captive pair of Otus asio (Screech Owl); other species probably not sufficiently studied.

CAPRIMULGIFORMES (nightjars). Apparently absent.

MICROPODIFORMES (swifts, hummingbirds). Apparently absent.

CORACHFORMES (kingfishers, bee-eaters, rollers, hornbills). Recorded in Alcedo atthis (European Kingfisher), also Upupa epops (Hoopoe) (incubation) and hornbills (incubation).

PICIFORMES (woodpeckers, jacamars, toucans, barbets). Recorded in Galbula melanogenia (jacamar). Apparently absent in Picidae (woodpeckers), though 'billing' has been recorded in Campephilus.

PASSERIFORMES (treated under families, and numerous families for which there are no positive or negative data are omitted):

Tyrannidae (tyrant flycatchers). Regular in Pyrocephalus on the Galapagos Islands (personal observation, also W. H. Thompson). Have found no other records. Pittidae (pittas). Recorded in Pitta cucullata in captivity.

Pipridae (manakins). Clearly absent in Manacus vitellinus.

Alaudidae (larks). Recorded only in Lullula arborea (Niethammer, 1: 159, 1937). Hirundinidae (swallows). Apparently absent.

Corvidae. Regular in Corvus spp., e. g., corax, corone, frugilegus (for all of these I have found references only to incubation), Coloeus monedula (Jackdaw) and Pyrrhocorax (Chough) including before incubation; also Pica (magpies) and various jays, i. e., probably found throughout the family.

Paridae (titmice). Recorded in most West European species of Parus (major, caeruleus, atricapillus, ater, cristatus) also Penthestes a. atricapillus in North America during incubation.

Sittidae (nuthatches). Regular in Sitta europaea, canadensis and carolinensis in courtship and incubation.

Certhiidae (tree creepers). Regular in Certhia familiaris.

Chamaeidae (wren tits). Absent.

Cinclidae (dippers). Regular in Cinclus aquaticus.

Troglodytidae (wrens). Apparently absent.

Mimidae (thrashers, mockingbirds). Apparently absent.

Turdidae (thrushes, etc.). Apparently absent in Turdus, also in Saxicola and Oenanthe. Regular in Erithacus rubecula (European Robin), occasional in the Bluebird (Sialia sialis) and Myadestes townsendi (Townsend's Solitaire) (personal observation of R. T. Orr).

Muscicapidae (Old World flycatchers). Recorded in Muscicapa striata and M. hypoleuca (incubation).

Sylviidae (Old World warblers). Recorded in Acrocephalus scirpaceus and (as an abnormality) in Phylloscopus collybita and P. sibilatrix; seems normally absent. Prunellidae (accentors). Occasional in Prunella modularis (Hedge Sparrow). Motacillidae (wagtails, pipits). Seems absent in wagtails, and usually absent in

pipits, but recorded (as an abnormality) in Anthus trivialis.

Bombycillidae (waxwings). Regular in Bombycilla cedrorum and B. garrulus. Laniidae (shrikes). Regular in Lanius ludovicianus, recorded in L. collurio (both preceding copulation and in incubation) and L. senator (the last, in incubation). Sturnidae (starlings). Absent.

Vireonidae (vireos). Not recorded.

Compsothlypidae (wood warblers). Recorded in Dendroica aestiva, castanea, caerulescens, and pinus, and Protonotaria citrea.

Ploceidae (weaver finches). Not recorded.

Icteridae (blackbirds, troupials, etc.). Never recorded, though several species have been studied in detail.

Thraupidae (tanagers). Recorded in captive Calospiza thoracica.

Fringillidae (finches). Regular in many genera, including Richmondena (Cardinal), Coccothraustes (Hawfinch), Chloris (Greenfinch), Carduelis (European Goldfinch, Lesser Redpoll, Siskin), Spinus (American goldfinches), Pyrrhula (Bullfinch), Pinicola (Pine Grosbeak), Leucosticte (Rosy Finch), Loxia (crossbill), Fringilla (Chaffinch), Plectrophenax (Snow Bunting) and all the Geospizinae (Galapagos finches). In some of these it has been recorded only during incubation, but in most (not, apparently, the Chaffinch) it also occurs before incubation. Typically, seems absent in buntings and American sparrows, including the well-studied Emberiza (Yellow and Reed Buntings), Zonotrichia (White-crowned Sparrow), and Melospiza (Song Sparrow).

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It seems better to depart from the usual custom and list the references in systematic order of the birds, not of authors' names. space, titles of papers are also omitted, but the name of the species referred to is retained.

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## SOCIAL NESTING HABITS OF THE SMOOTH-BILLED ANI

#### BY DAVID EDWARD DAVIS

## INTRODUCTION

The study of the social nesting habits of the Smooth-billed Ani, Crotophaga ani, a species which builds communal nests, was undertaken in order to increase the information about the subject of social parasitism and in order to help clarify the concept of territory. In this paper these two problems are considered in relation to the behavior of this bird.

The field work for this study was done at the Atkins Institution of the Arnold Arboretum of Harvard University at Centrál Soledad, Cienfuegos, Cuba. This Centrál is a large sugar estate, and the arboretum is an oasis in a desert of cane, since the only other places suitable for birds to live are roadsides, pastures, and a few spots unfit for cultivation. In addition to the field work at the arboretum, short excursions were made to the nearby Trinidad Mountains and also to Bahia Honda, in Havana Province.

The species studied, C. ani, belongs to a distinct subfamily, the Crotophaginae, of the Cuculidae, and occurs in the West Indies and South America. Included in this subfamily are C. major, inhabiting northern South America, C. sulcirostris, ranging throughout Central America, and Guira, a monotypic genus found in Brazil and Argentina (Peters, 1939). The habits of the members of the subfamily are discussed in innumerable collector's notes, which usually repeat the observations of the natives. Guira, the most primitive in generic characters, is poorly known but seems to be the least specialized in its behavior; these birds are reported to build their own nests, sometimes in colonies, and also to lay eggs in the nests of other birds. The life history of C. sulcirostris has been studied by Skutch (1935; 1937), and resembles that of C. ani. The habits of C. major, also social in its nesting behavior, have been observed by Young (1929). The behavior of C. ani is described by Gundlach (1874; 1895) who made very accurate but brief observations on the species in Cuba and by Young (1929) who briefly discussed the bird's habits in British Guiana. More recently Dr. Frank M. Chapman (1938), describing the history of the colony at Barro Colorado Island, has given the only

<sup>&</sup>lt;sup>1</sup>Thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy in the Division of Biology of Harvard University, June, 1989.

accurate account of the species. In addition, a mass of data concerning the genus, some of which is correct, was collected from travellers by Leverkuhn (1894).

I am indebted to many persons for assistance in this work. Mr. David Sturrock and Mr. F. G. Walsingham, of the Atkins Institution, made the complete facilities of the laboratory available, and Mr. William Leonard of Central Soledad granted innumerable favors. I am indebted to my friends there for making my stay most pleasant. This study was made during the tenure of an Atkins Traveling Fellowship and with the aid of a grant from the American Association for the Advancement of Science. I wish to acknowledge the painstaking criticism of Dr. Glover M. Allen. Without the encouragement of Dr. Thomas Barbour, this study never would have been made.

#### **METHODS**

A study of bird behavior in the wild is dependent upon the methods of field observation. To observe the bird's behavior I carried on studies from May 8 to September 13, 1937, and from April 8 to October 16, 1938. During these two breeding seasons I spent approximately 1300 hours in the field. The fact that the birds of a group sleep in the same tree made it possible to keep account of the different groups by coming to the garden at dawn. In trying to follow several groups intensively there are innumerable practical difficulties, and deficiencies in the records inevitably result. The identification of individual birds was made possible by the use of colored leg-bands. During the two years, thirty-three adults and fifteen young were trapped and banded. In addition, the fact that the yearlings are distinguishable by the bill for nine months after hatching aided greatly in identification. In order to study the nests at close range a blind twenty-four feet high was built and placed at several different nests.

The best method of presenting to the reader a picture of the bird's behavior is to use descriptive words, such as 'complaint,' 'perplexed,' 'mad,' and descriptive phrases. In this connection I wish to emphasize the fact that these terms are used merely for description, and that no knowledge of the state of the bird's mental processes nor of purpose is implied. Throughout this paper direct quotations from my field notes are preceded by the date and enclosed in quotation marks. The vernacular names 'ani' and 'judio' are used, and the terms 'colony,' 'flock,' and 'group' are 'used synonymously. For convenience each colony was named.

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## PART 1. SOCIAL HABITS

#### FLOCK BEHAVIOR

Crotophaga ani is a social species, living throughout the year in groups. Although occasionally a pair may live alone, usually the number in a flock is about seven; the largest group recorded by the writer contained twenty-four, and groups of fifteen are not uncommon. Since the number in the colony is continually changing, it is meaningless to derive an average size. In most flocks there is a surplus of males, although colonies composed of an equal number of each sex or having an excess of females are not uncommon. These flocks retain their individuality for a year or more. Although the yearlings remain with the flock throughout the year and may breed with the parent flock, in general there is a sharp decrease in the number composing a group (Table 1) just before the building of the first nest. In one case (Cypress) this decrease corresponded to the number of yearlings that were in the group.

The membership of each flock gradually changes, especially in the period just previous to nesting. Individuals of both sexes may leave the colony for no apparent reason and wander about searching for a colony to join. Table 1 shows the changes in number in the groups studied intensively during 1938 although the addition of new individuals is masked by the decrease due to mortality, and by departures.

TABLE 1

			POPULA	ATION CI	HANGE (19	338)			
Date Colony	4-16	5-8	6-5	7-3	7-31	8-28 (adult	9-25 s only)	Date star	s nest
Pond	20	18	15	14	14	13	13	6-10;	8-10
Gnhs	11	9	8	6	6	6	6	5-20;	7-10
Ceiba	11	11	9	5	4	3	3	7-20	
Cypress	10	10	7	6	5	5	4	6-10;	9-16
Haemat	8	9	6-8	7	6	6	4	6-18	
Phoenix	11	13	5 <sup>±</sup>	7	6	6	6	6-25;	8-19

Some evidence suggests that a colony may divide into two parts. Certainly during the summer and probably during the entire year, new groups form. A typical history of a colony that developed but did not breed is as follows:

July 7. Four birds have taken up territory.

July 10. Still fighting for part of their area.

July 25. Five birds in the group.

July 26. Started to build a nest.

August 4. Still working on the nest; abortive type.

August 10. Fighting in the territory.

August 20. Group gone.

Less commonly these new groups may complete the nest and raise young. A colony may disintegrate if most of the individuals are removed. Although one nest held six incubated eggs, it was deserted when three out of four of the colony were shot. The remaining bird did not get a new mate.

The members of a flock pass the day together. Each colony sleeps as a group in a densely foliaged tree or in a bamboo clump. Sometimes the group may sleep in two parts and the sleeping tree may be changed occasionally, depending upon the number of suitable trees in the territory. In the tree the birds crowd as close together as possible in rows on a limb, pull the head down on the shoulders and fluff out the feathers. Shortly after dawn the birds come out and sit in a group on a branch, sunning themselves and trying to keep warm. Throughout the daytime the flock spreads out over the feeding area, using the 'judio' call to keep together. At evening before going to the sleeping spot the birds collect in a nearby tree and then fly in together.

The individuals of the flock respond to the actions of their fellow members in several ways. First, the birds are very solicitous for other individuals of the flock, crowding around with great excitement when one member is hurt. This behavior was observed when a dove fluttered off its nest and performed 'injury-feigning.' Second, the birds spend much time preening themselves and one another. When two birds are sitting adjacent to each other, one may suddenly stretch out its neck and raise its neck feathers in a movement resembling a reflex, which is stimulated by the touch of the bill of the other bird or arises spontaneously. The other bird then carefully preens its head and neck feathers, pulling out and swallowing all the loose ones. Then the situation may be reversed; or two birds may work on one simultaneously. Third, among the individuals it is probable that there is a flexible order of social dominance, although no criterion was found suitable for judging the rank of a bird. Sometimes two birds scuffle over an insect.

Albino birds occur and are reported by the 'guajiros' to live normally with their respective groups.

#### TERRITORIAL BEHAVIOR

Each flock of *C. ani* possesses a definite territory which it defends against strangers. The boundaries are well known to the members of the colony and are not passed. The individuals cannot be driven from their territory, even when pursued by a man. The size of the territory varies roughly in proportion to the number of birds in the

colony, but is also related to the previous history of the group; a colony reduced in number will nevertheless retain the same territory for a long time. In large colonies (fifteen birds) the territory may occupy ten acres. The territory contains (1) a nesting and sleeping and (2) a feeding division. The size of each division is dependent upon ecological conditions. The nesting section contains several bushy trees for building the nest and sleeping at night, while the feeding area resembles savanna conditions. Except when engaged in nesting activities, the birds spend the day in the feeding division.

Throughout the year there are changes in the boundaries, as shown by the map (Text-fig. 1). A part of the territory not defended may be taken over by a neighboring group in a few days. For example, in July the W. of G. group was not present and the Ceiba group took over part of its territory. A group (Pond) slept about a quarter of a mile out in the cane fields for several nights. Since, for the first few days after the young are out of the nest, the colony sleeps in the feeding area, another colony may attempt to occupy the nesting division and sometimes succeeds in doing so. If in the dry season there are no moist places in which to find insects, the area is deserted, or contracted around the stream courses. The territory is vigorously defended against other individuals. Although any invasion is immediately repelled the colonies are on good terms with their known neighbors and settle boundary disputes quickly by 'agreement.'

Strangers of two distinct types try to invade the territory. One type comes in from a distance, flying high, sits in the top of a tree and calls whew several times. This behavior attracts the owners of the territory and the stranger leaves, still flying high, without attempting to join the colony. It seems likely that birds of this type are yearlings, not yet sexually mature. The second type of stranger tries to join the colony. Quietly it enters the territory and when the owners arrive it remains in the vicinity. One or more owners chase it throughout their area, sometimes flying high above the ground but more often circling near the ground. The stranger sleeps in the area but in a different tree and does not know the boundaries of the territory, but may fly into a neighboring territory, only to be chased again. Although strangers sometimes try to join the colony when it has a nest or young, they are less aggressive at this time. As soon as the young are hatched the strangers again aggressively attempt to join the colony.

The behavior used in driving away strangers is referred to as 'chasing' and is described in the following note. June 1, 1937: "Chas-

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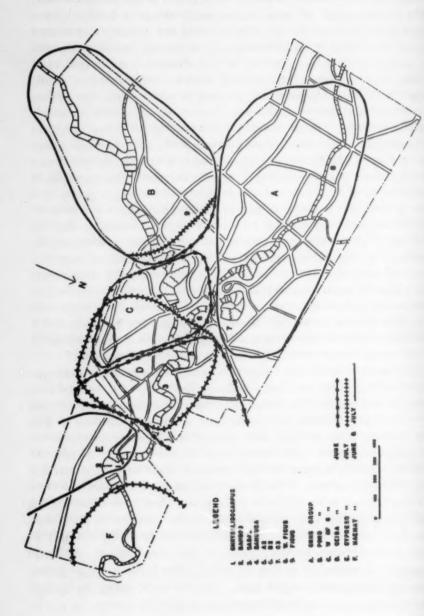
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TEXT-FIG. 1.—Territories for June and July 1938.

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te ig pu in ing is an interesting procedure. One bird follows another around and around and back and forth. Sometimes another joins in the pursuit. They fly for about twenty beats and then sail for a long distance. They are able to turn and wheel in the air quite well. . . . It (chasing) starts when two birds are in a tree and one starts 'conking.' The chased then starts to climb and the chaser follows, hopping up the limbs and twigs. Then the chased starts to fly and is followed." This chasing behavior may last for several days, until the stranger is driven out or succeeds in joining the colony, as shown in the following note, July 26, 1938: "Saw a chaser lose a fight with the chased but another bird came to the rescue. The birds chased all morning." Chasing occurs throughout the year but, since just before the breeding season the birds are moving around more, it is more frequent at this time. If the stranger comes while the nest is being built, the nesting may be interrupted and delayed.

Chasing is interpreted as part of the mating behavior by Young (1929). Although in appearance it resembles the mating flight of many birds, especially the ducks, the following facts make it necessary to discard this interpretation. (1) A bird may be on the nest while other birds chase. (2) Chasing may occur at any time of the year, or at any time during the nesting cycle, but does not occur in some colonies. (3) There is a definite mating behavior as described below. (4) There is a definite antagonism between the birds concerned and sometimes fierce fights ensue.

A behavior related to chasing may be called 'rushing.' Uttering a particular call (no. 3), the birds as a group fly from tree to tree. Since this behavior occurs after a period of chasing, it seems to be a method of defining the limits of the territory and searching for any strangers. Other than this 'rushing,' there is no special advertisement of the territory such as there is in passerine birds.

There is no fighting when birds from several different colonies are placed together in a cage distant from the birds' territories. The birds sleep side by side the first night.

The chasing, rushing, and fighting to defend the territory are very fierce. The impulse to defend is so strong that the birds fight a stranger even while a man is at the nest. Stuffed birds placed in the territory are attacked and destroyed, although at times the dummy is ignored, as shown by the following observations. June 24, 1938: "I put the dummy at the nest. After about 45 minutes four birds came in. Two sat on the nest, each for a few minutes. They ignored the

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dummy in spite of moving and shoving it at them. They then went away. III came in with a leaf but dropped it and went off." June 25: "The dummy is thoroughly damaged on the back and legs and is upside down. Three birds came back and III sat on the nest and complained a lot. They ignored the dummy although I moved it a lot. III brought in some leaves and sat ignoring the dummy." When attacking a strange bird, the defender spreads its wings and pecks viciously at the invader's head. Fights occur if, during chasing, the chaser overtakes the chased. As the two fall to the ground, screaming and fluttering, the whole colony forms a circle and watches the brief combat. A fight or display performance, described as follows, occurs occasionally. June 19, 1937: "Two birds are on the ground. One started to display in front of the other. It would strut around it and spread its tail and wings. Sometimes it would fall forward as it displayed and raise the tail high in the air. All the time the two were making little noises. At one time there seemed to be a sort of abortive attempt at a fight." The birds then separated and went into different territories. This behavior is probably a territorial dispute.

Possibly birds join a colony without fighting, as suggested by the following observations. July 7, 1938: "Saw AR and A-B sitting peacefully with two other birds in the sabal tree. Later saw two birds chase away a stranger that had 'whewed' from the top of the ceiba tree. AR is on excellent terms with the birds of the Ceiba group. It had its neck scratched and went up to the nest (location). I have watched the birds of this group fairly closely of late and they have been doing a lot of chasing, but I did not see them chase AR, although they could have very easily." AR was formerly a member of the Greenhouse group and was concerned with the nest on June 18. On July 3, the nest was destroyed and it is likely that AR left at that time and joined the Ceiba group.

Birds may leave the colony without being driven out. On July 26, 1938, ARR (female) was on good terms with the rest of the group. She left on July 27 and formed a colony with two males nearby. On July 30, a member of her former group chased her.

There is no difference in behavior among the sexes or immatures in fighting or chasing. Males may chase females and vice versa. When I arrived in April, 1938, birds hatched July 9, 1937, were defending their territory.

The birds will fight a mirror as would be expected, since, although they recognize the other members of the colony, they are not acquainted oril

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with themselves. This behavior occurred on October 4, 1938: "I put the mirror at the nest and two birds came on to the nest at once and started to conk and peck at the mirror. It puzzled them greatly especially when they went around behind it. After I took it away they explored the place looking for it and finally went on to the nest."

Fighting is frequently caused by a colony travelling as a group in search for a new territory. In the spring months when the birds are taking advantage of the regions made suitable for nesting by the rains, this travelling is often seen. For example, on April 20, 1938: "Six birds were seen in W. Ficus at 6.30 a. m. They seemed to have a purpose and eventually flew northwest in stages and then to the north out over the cane." In one case a pair which tried for several days to join the Pond group but was repulsed at the nest each time, later built a nest and laid five eggs. The birds arrive in an area and sit about in trees for a while to establish territory. If there is a claim for the particular area brute force decides the issue. The first stage is chasing; the second is rushing and the third is the acceptance of the boundaries or the withdrawal of the unsuccessful group. If there is no claim for the territory, it is at once defended against other groups.

By taking advantage of the fighting behavior, it was found possible to catch the birds, using a live decoy in a trap. A dead or mounted decoy is ineffective, probably because it is not moving and hence is not seen. The owners of a territory enter the trap and in a short time kill the decoy. The decoy does not resist. The birds continue to fight with the decoy until a person is within a few feet.

Several times an interesting conflict between the territorial behavior and the response to the alarm call was observed. Two colonies had nests close together, although their territories extended in opposite directions. When the nest of one colony was disturbed the birds of the other colony responded to the alarm call but never crossed the invisible boundary line of their territory.

#### CALL NOTES

The vocabulary of *C. ani* is varied and distinctive. Each call has definite uses and may serve to distinguish behavior patterns. The first six calls listed below are modifications of no. 1, but the other calls are not founded upon a common pattern. The calls have been given descriptive names which may assist to convey their characteristics. *Mimus polyglottos* mimics some of the calls, especially the 'judio' call and causes confusion not only for the investigator but for the anis themselves.

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No. 1. 'Judio' is the flock call, used whenever a bird is flying for a distance or when the group is travelling to the feeding area, to notify the members of the movements of the group. This call resembles the Spanish word, thus giving rise to the Cuban name for the bird.

No. 2. The alarm call is used as a signal of warning or annoyance. When a person approaches the flock one member gives the call and the rest of the birds fly upward to a bush or tree and continue the alarm until the annoyance passes. The note is rapid and not nasal, but begins with an  $\tilde{n}$  sound. At each utterance the tail jerks. The young develop this call first, but require a month to reach perfection.

No. 3. The 'shout,' always repeated very rapidly, is used during the rushing behavior described above.

No. 4. The 'complaint' is a slow, high-pitched wail, similar to the alarm but higher in pitch, and is used only at the nest and mainly during the first few days of building. This call is a certain sign that work is in progress but does not distinguish between an abortive nest and a real one. The note is not given after the nest has been built but is used after pairing occurs. Hence it is a nest, not a pair, call. It should be noted that there is a special call for the nest but not for the territory as there is in many species. It was not possible to determine if this call is given by one sex only.

No. 5. The 'objecting' call is an undeveloped alarm which resembles a 'complaint' in tone, and is used at the nest when the birds are disturbed. First, the alarm call is used and then as the disturbance lessens the 'objecting' call is continued. Sometimes it is heard when a bird wants to exchange the duties of incubation with the bird on the nest.

No. 6. The 'get-up' call, repeated extremely rapidly, is used early in the morning before the birds leave the sleeping tree and sometimes late in the evening before the birds go to sleep. It is also used to attract the young birds out of the nest for the first few times.

No. 7. The 'chuck' resembles the sound ah and is used by the bird being chased but not by the chaser. Although the significance of this observation is not understood, several times in April this note was heard under circumstances which normally result in the alarm note.

No. 8. The 'chuckle' is used in the nesting tree when the birds are pairing.

No. 9. The guttural note occurs whenever the birds appear perplexed. This call is induced by a strange object such as the blind or a strange situation such as being caged. No. 10. The 'whine' is a soft call used in mating. The pair sit in the nesting tree side by side and whine, so softly that the sound cannot be heard more than twenty feet.

No. 11. The 'conk' is used in fighting to defend the territory. After getting below the stranger, the attacker 'conks' a few times before attacking.

No. 12. The danger call is a 'quack,' signifying the approach of a hawk. The judios dive down into a bush or tree at this note. Immature birds give this call on seeing *Cathartes* and *Zenaidura*. Once, when the investigator was placing a decoy near the nest, this note was heard, perhaps indicating the highest pitch of excitement. Other species take advantage of this warning.

No. 13. The 'whew' is used by a stranger of the first type described above.

### PAIRING AND NESTING BEHAVIOR

The nesting season begins shortly after the rains permit the vegetation to develop. At this time the diet changes, as shown by a study of stomach contents, from vegetable to animal matter (insects and lizards), and it seems likely that this change of diet is the stimulus for the development of the gonads.

The pre-incubation behavior takes place in several stages. (1) A pair or several birds spend part of the time away from the flock sitting quietly in a tree suitable for the nest. The manner of sitting differs from the type usually observed; the birds sit inside the tree, not on the top or outside. The birds sometimes hop about in pursuit of each other and after the first day or two occasionally break off a twig, but usually drop it. A bird may hold a leaf in its bill for a time or take one from another bird and then drop it. During this period occurs the whining note, which, except for the action of sitting side by side, is the only courtship behavior. The following note records typical behavior. May 21, 1938: "Four birds of the Cypress group were in the bamboo. One (ragged tail) whined for a long time and hopped around the bamboo, finally flattening itself out. The others showed no interest. Another . . . seized a twig but did not break it off and soon lost interest."

(2) Next comes the period of the complaint call, given persistently from a definite location. The observation on May 26, 1938, is typical of the behavior at the beginning of this period: "I went over to the Old Garden at 7.15 a. m., and found three birds sitting in the bamboo. One carried a leaf around after a while but did not know exactly

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what to do with it and finally dropped it. Again it carried a leaf around. Moving the tail up and down seems to be characteristic of this time. The birds also complained a bit and whined some. A bird went up into the Ficus and pulled a twig and then was joined by another which also pulled. They sat for a long time and were still there when I left at 8.45." Although by this time the site for the nest has been determined, some birds may examine other locations. June 30, 1938: "At 7.00 a. m. there were two birds near the Sabal and three in it. They sat for a long time and then went over to the Bambusa and sat some more. Two birds left and two . . . more stayed and hopped around a long time. Then they went out and joined the others. Three went over to the Sabal and 'split-tail' went to the nest (location) in the Sabal. The whole group went over to the Bambusa. They cannot decide which to use."

(3) After the location of the nest is determined in the period of the complaint call, the birds begin the period of building. Twigs are broken off from a branch, never picked up from the ground. Usually one bird builds most actively but frequently as many as five carry in twigs at the same time. At this time the birds are so absorbed in nest-building that the approach of the investigator does not disturb them to any extent. The complaint call continues throughout this stage. Sometimes two birds may sit on a nest, side by side, as shown in this field note. June 7, 1938: "One bird in the Chrysalidocarpus complained and another came in from the Litchi. Both sat on the nest for three minutes and then went to the bamboo and sat."

(4) Following this stage for a few days little or no work may be done on the nest.

(5) In the last stage before the eggs are laid, the birds carry in leaves and occasionally a few sticks. An interesting action was observed in a colony which was building a nest after the first nest had been destroyed during incubation. A female sat on the nest and received sticks and leaves from the male, thus continuing perhaps the incubation which she had been performing on her former nest.

Copulation, the climax of pairing behavior, occurs usually in the first hours of the afternoon, but may occur at any time of day. The action shows no special behavior. When the birds are sitting in the nesting tree quietly, the male, without any preparatory performance, mounts the female. Because a stuffed bird is treated as a stranger and attacked, the birds do not copulate with it.

Many irregularities from the general outline above occur. The

nesting behavior may stop at any stage. For example, on June 9, 1938: "One bird interested in the W. Ficus. It hopped around in the tree, sat for a while and complained all the time." No nest was built in this location. In some colonies the birds may break off twigs and then leave the territory, or a nest may be started but not completed. These incomplete nests are termed 'abortive' and, as discussed below, are comparable with the scrapes and trial nests of other species. After an abortion the colony usually starts another nest in another location. That a poor choice of nest site is not the cause of abandonment is shown by the history of the Pond group. This group built an abortive nest in a bamboo and then, after raising a brood elsewhere, came back and built on top of the abortive nest.

A type of irregularity occurring occasionally is desertion. After building a nest and laying eight eggs, one group deserted without obvious reason and built the nest in another place. The birds under observation never deserted the nest because of human interference.

Other aberrations of the breeding cycle occur. A bird was observed carrying sticks alternately to two different trees, indicating that the same bird may work on two nests. Although part of the group may start the nest, others in the colony may take no interest till later; the Bambusa group in 1937 consisted of fifteen birds, yet only nine eggs were laid, indicating that only two females had laid in the nest (evidence presented below shows that females lay between four and seven eggs, usually six). Only exceptionally do all the females of a group lay eggs at the same time. Often one bird, either male or female, is most interested in the nest, is most alarmed by the observer, and is most active in the building and incubation.

At the beginning of the laying period there often is a miscarriage of the building and laying sequence. Sometimes eggs are laid before the nest is completed and are covered in the bottom of the nest or dropped on the ground. One day a colony of fifteen birds dropped six eggs, some as far as twelve feet away from the nest. By placing the unbroken ones in another nest, these eggs were proved to be fertile. Although there is no evidence that the females fight on the nest, occasionally eggs may be knocked out of the nest.

If a nest containing eggs or young is destroyed the birds rebuild at once and with great speed in some cases, telescoping the stages into a few days. Table 2 shows that there is no relation between the stage of incubation or feeding at which the nest was destroyed and the length of time till a new nest is started.

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TABLE 2

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REBUILDING	DATES I	N REL	ATION TO	NEST	DESTRUCTION

Colony 1937		Number birds Date Stage of at 2d laying destroyed nest		New egg date	Days	
Old Ga	rden	12	8-1	3 days incubation	8-12	11
C <sub>3</sub>	(2)	11	7-5	o days incubation	7-13	8
C <sub>3</sub>	(3)	6	8-10	5 days incubation	8-16	6
Cocos	(1)	5	6-14	4* days incubation	6-25*	. 9*
	(2)	4	7-1	o days incubation	7-14*	13*
	(3)	7	7-20	12 days incubation	8-3*	140
Gray's 1938		11	7-5	1 day hatched	7-10*	5°
Cypress		7	7-5	4 days incubation	7-10*	5*
Gnhs	(2)	7	7-3	1 day incubation	7-10	7

\*indicates estimate of ±2 days.

### RELATIONSHIPS BETWEEN MALE AND FEMALE

Since the birds live in colonies and build communal nests, polygamy may occur. Copulation with more than one individual is the only criterion of polygamy, but since in this species copulation occurs only in very dense foliage, the number of copulations clearly observed is small. Of those copulations seen, none proves a departure from monogamy. In two colonies in which all individuals were identifiable (Ceiba and Cypress), the behavior indicated strict monogamy. Thus, in the Ceiba group all four birds were identifiable and only one pair was concerned with the nest and young while the other pair took no notice of the nest. There were only seven eggs, indicating that only one female had laid. This colony, therefore, consisted of two definite pairs. As another example, at the time the first brood was raised the Cypress group consisted of two definite pairs and two non-breeding birds. At the time of raising the second brood, the group consisted of one female (ABW) and three males (ARW, ARG, and ABB). All relations were harmonious and it was impossible to see any difference in the female's attitude toward the different males.

In many cases, however, polygamy is suggested by the composition of the colonies. In some colonies polygyny is indicated. A colony which consisted of two females and one male was collected and nine eggs were in the nest, indicating that both females had laid. Since the previous history of the group is not known, it is possible that there was another male at the time the eggs were laid. In its second nest, the Phoenix group, which consisted of seven birds, had 23 fertile eggs, and hence, unless some bird laid eight eggs, polygyny must have oc-

curred. But on the other hand, the composition of other colonies suggests polyandry. The Bridge group, which had four eggs, consisted of two males and one female throughout its history. A colony that consisted of four males and one female was collected. In these two colonies there is no proof that more than one male copulated with the females, although at no time were sexually inactive birds collected in any colony. In conclusion, it seems that any of the three possible situations, monogamy, polyandry, or polygyny, may exist.

At the time of pairing there may be antagonism between the pairs. This behavior occurs in the early part of the breeding season, as shown by the following observations. May 23, 1938: "AW followed A into the C3 (a bamboo) and hopped about it for a long time. It was up in the bamboo and I could not clearly see what went on. There was a lot of whining, often scarcely audible. Then a third bird came in. I could not get a look at its legs and it may have been banded. It joined the others and there was some 'conking.' Presumably AW was mad but I did not see well enough to be sure. Then they went out to the west." June 10, 1938: "Three birds came into the Chrys nest at 5.30 p. m. and then 'ragged-tail' came in. A male attempted to copulate but the female was not very responsive. This occurred on a branch near the nest and they both went over to the nest where 'raggedtail' was. They hopped around the bamboo and there were a few 'conks' and then they went out to feed." But in contrast, later in the season there is no antagonism. On July 9, 1938, the behavior of the birds ARG and ABW, which were certainly a pair, was recorded: "ARG was actively carrying twigs in to ABW who was sitting on the Two birds came in and shoved ABW off the nest. ABW and ARG went out together, followed by the third bird and the fourth stayed on the nest. ARW came in and stayed on the nest and then copulated with the bird on the nest." July 11, 1938: "Four birds came in to the nest in the Bamboo and ARW and ABW sat on the nest together. Then ARW and a bird went off and ARG began to carry in twigs to ABW on the nest and did so industriously for about 15 minutes." These data indicate that at the time of pairing there is antagonism but that after the mates are determined there is harmony.

Both sexes incubate, although in some cases the male does more than his share. When a bird desires to incubate, it flies into the nest, usually with a leaf or sometimes with a stick. If the incubator does not wish to leave, it must be forced off or the newcomer is unable to incubate. The general behavior is recorded in the following ob-

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ggs, ocservations. July 26, 1987: "A bird brought in a leaf and sat on the nest for a minute trying to get the other bird off; but then left. It soon came back and sat with head and breast over the other's back. called and then left. Again the performance was repeated. It came in with a twig but still the other stays on. Two more sticks are brought in in quick succession to no avail. The bird sat on the incubator and called but soon left. Another stick was brought in and the incubating bird took it. Then it (the first bird) brought in another stick. Now it is sitting on the incubating bird and calling. A third bird came in with a stick and both got off. The third bird got on the nest." July 30, 1937: "Several young have their eyes open. Four different birds brought in food at the same time. The incubator left. There are some birds sitting around all the time. Once two birds came in and both seemed to want to incubate. A third did not seem to know what to do with some food. All three stayed on the nest for a while. Finally two went off. Later two brought in food. The young did not eat (the food) offered by one and so the adult ate it." The delay in the departure of one bird is the basis for the belief that more than one bird incubates at one time. According to my experience two or more birds never incubate simultaneously.

# RELATIONSHIPS BETWEEN ADULTS AND YOUNG

The young remain with the parent flock for a variable length of time and in some cases nest in the same tree in which they were hatched. For example, the young from two colonies, banded in 1937, were found in 1938 with the parent flock, sleeping in the same tree used in 1937. Nevertheless, in general, most of the young have wandered away by the breeding season. In one case the yearlings sat in the nest tree and seemed interested, but in a few days disappeared; since no chasing or fighting was observed, it is unlikely that they were driven out. The yearling cooperates with the parent flock to defend the territory.

Nearly all the adults in the colony feed the young, although some individuals are much more active than others. For example, in the Bambusa nest there were nine young, indicating that only two females had laid, but at least nine of the fifteen birds in the colony fed these young. In the Cypress group a female did not incubate, although, as shown by sections of the ovary, she had laid eggs. Nevertheless she did feed the young.

The adults call the young out of the nest by the 'get-up' call (no. 6). If the nest is threatened the adults give the alarm note and in addi-

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tion click the bill; then the young, although they may be only four days old, climb out of the nest into the tree. The young return to the nest the first two nights after leaving it. One adult sleeps with the young for several days after they have left the nest but are still in the nest tree. After the young are able to fly, the adults take them out to the feeding area and the whole colony sleeps there. The young are fed by the parents for about a month after leaving the nest. If no nests are destroyed a colony in Cuba can raise three broods in one season.

The young are ineffective as a decoy to trap the adults.

# RELATIONSHIPS AMONG THE YOUNG

The young of one brood stay with the parent flock while the next brood is incubated and hatched. Observations on the second brood are not satisfactory because the adults become so alarmed. The observer has spent three hours hoping that the birds would quiet down and resume normal behavior. This behavior is in great contrast to the behavior during the development of the first brood.

The young of the first brood may feed the young of the second brood, but they are less active than the adults. In Wares' nest in 1938 the young when 48 days old fed those of the second brood. Analysis of this behavior suggests that the young birds are mimicking the adults, as the individual does in all behavior, or that, as in the case of non-breeding birds, the stimulus of the young in the nest is a releaser which compels the bird to bring in food.

# PART 2. LIFE HISTORY

### GENERAL CHARACTERISTICS

As individuals, judios show distinctive behavior patterns. The birds sit for interminable periods, preening or doing nothing; an hour is not an unusual length of time to spend in one spot. In the early morning hours when they come out of their sleeping tree, they spend a long time sitting and working over each other's feathers and stretching their wings out in the sun to dry, frequently shaking the tail rapidly from side to side. After a hard rain the birds may sit out on a limb in an extremely bedraggled group. During the rain the birds sit together in a sheltered place and try to keep warm and dry; if it is late in the afternoon they make a dash for the sleeping tree. In the heat of the summer the birds pant much of the time during the warm part of day. In the cool and dry season they spend the cooler morning hours sitting on the ground in a dry place, protected

from the wind. When it is cold, a bird on the outside of the row may hop on to the others and squeeze down between them.

The behavior of the birds indicates a lack of ability to withstand low temperatures. To analyze this situation the weight of the feathers was calculated by obtaining the difference between the weight of the bird before and after stripping it of all its feathers except the remiges and rectrices. For six specimens (three males and three females) of C. ani the feathers averaged 3.03% of the body weight. From the data of Kendeigh (1934) the average value for twelve species of temperatezone birds is 4.26%, suggesting that such birds in general have a greater feather covering than C. ani. To get a valid comparison the feather weights of tropical birds should be compared, however. The feathers on one specimen of Ptiloxena atroviolacea weighed 3.7% of the body, which suggests that C. ani may differ from even tropical birds in the small amount of feather covering.

The birds are awkward in all movements. They walk with a peculiar disjointed gait and sometimes run a few feet; on the ground they seldom hop. In flight the bird flaps and soars alternately and when landing in a tree, the wings and tail are uncontrolled. Although sometimes taking the trouble to arrange the tail and wings, the bird usually leaves them just as they fell.

The birds feed almost entirely on the ground, searching through the grass and pouncing upon the hapless insects or following an ox to snap up the insects it disturbs. In catching an insect the bird makes a dive, the wings flop, and the tail waves in the air. On April 13, 1938, judios were observed catching junebugs on the wing, in the manner of a flycatcher. The birds were usually successful but never graceful. The birds were never observed eating ticks although they are reputed to do so in Cuba and certainly do so in other West Indian islands. The fruit of the royal palm (Roystonea) is swallowed, the hull removed in the gizzard, and the seed regurgitated. In the dry season the birds drink water, raising the head to swallow.

Captive birds were unable to learn to eat non-moving food, and therefore starved. Some of the birds lived as long as eight days, presumably without eating anything.

A difference in size, which with practice can easily be recognized in the field, distinguishes the sexes. The mean of the weights of fourteen males is 114.3±2.26 grams and that of ten females is 97.0±1.78 grams. The standard error of the difference between the two means is 2.88 grams and hence the difference is very significant. Since these

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weights were generally taken in the morning they are comparable. Baldwin and Kendeigh (1938) consider the difference in weight of males and females to be significant if it is more than 3% of the weight of the male. Since for *C. ani* this difference is 14.9%, it is certainly significant. Females at the time of laying may weigh as much as a male. A female containing an egg ready to lay weighed 123.2 grams and even after the egg, ovary and oviduct were removed, she weighed 112.0 grams. Large amounts of fat were deposited in the abdomen. A female with an egg, collected by Danforth (1937), weighed 115.6 grams. This evidence suggests an increase in fat deposition at the time of laying, although Riddle (1934) has found in pigeons an increase during the incubation only.

In the population at large there is an excess of males. Table 3 shows the data on the sex ratio. Using the Chi-square tests, the museum data are statistically significant. There is no reason to

TABLE 3

	SEX RATI	10	
Source	Males	Females	Ratio
Museum collections	401	328	1.22:1
Cuba, 1937-38	35	24	1.46:1
Embryos, 1937-38	29	16	1.53:1

believe that the collections in the museums are not a representative sample of the population; there are no behavior differences which would influence the collection of either sex and there are no color differences. The data for the embryos (sex was determined by sectioning the gonads) and for the birds at Soledad are consistent but not significant statistically. The factor of longevity may be neglected in the consideration of the sex ratio because the point to be established is that in the breeding population there are more males than females.

#### NEST

The location of the nest is indicated by the complaint call, first uttered by the bird several days before the actual work is begun. The nest is placed in the fork of a thickly foliaged tree or in a bamboo. The size of the nest is dependent upon the configuration of the site of the nest and the number of birds bringing in material. The usual dimension is about a foot in diameter and, if the nest is placed in a deep fork, it may be six inches deep. To build the nest, sticks are broken off nearby trees and later fresh leaves are pulled from twigs

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and carried in. Material for the nest is never picked up from the ground. While working, the individual goes to the same tree repeatedly for twigs. The work is done mainly in the morning. When the nest is robbed, it is covered with leaves and a new nest is started in another place at once.

#### Eggs

The egg of *C. ani* is blue and measures about 35 by 25 mm., although there is great variation in size. There is a white chalky covering, which may be secreted by special cells in the vagina of the oviduct, as suggested by a preliminary study.

The incubation time, as shown by Table 4, is about thirteen days. Due to the heat of the day and the length of time an egg may be in the nest, some eggs hatched within six days after incubation proper started. By changing the eggs, a colony of three birds was kept incubating for twenty-four days. For the first few days after incubation starts, the eggs are not warmed continuously but only for short intervals as shown in this observation. June 23, 1938: "Watched the Cypress nest for half an hour before a bird came in. Then (no.) I came in, sat around, flew back to the bamboo, was joined by ARW and came back. Another bird (III) came in from the Cypress tree with a twig and incubated but was very restless, often adjusting the twigs. It came off the nest and complained a bit and left. It came back with a stick. I is still sitting around. III came off the nest, complained, and left." After this period the incubator never leaves

TABLE 4

		INCUBAT	ION PERIODS	
Colony 1938		Eggs	Days incubated	Days between start of laying and incubation
Bridge		4	14	7
Pair		5	12	2
Mango		5	12	2
Phoenix		21	9	9
Pond		22	6	18
Greenhouse		11	13	2
Ceiba		7	15	3
1937				
Old Gard.	(1)	6	13	7
Old Gard.	(2)	10	15	7
C <sub>3</sub>		14	13 (estim	ated) 10

the eggs until another bird comes in to brood. Birds may incubate for a short time immediately after the eggs are taken from the nest.

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For example, on July 5, 1938: "Jim climbed over and got the eight eggs. III came back at once and incubated. Then II came in, exchanged and incubated."

The number of eggs laid by each female is difficult to determine. In an attempt to determine the number of eggs laid, serial sections of the ovaries of several females were studied. However, the peculiar development of the corpus atreticum prevents, as explained below, this determination. As a result it is necessary to use indirect means to determine how many eggs are laid by each female. Table 5 shows

TABLE 5

			NESTING DAT	A		
Colony		Date	No. of	No. of	Laying	Immatures
1938		laying	birds	eggs	females	
Bridge		8-12	3	4	1	0
Pair		8-22	2	5	1	0
Wares	(1)	7-18	7	8	2	6
	(2)	8-30	5	105X	2	6
Ceiba		7-20	5	7	1	4
Gnhs	(1)	6-18	7	12X	2	-
	(2)	7-10	7	12	2	0
	(3)	8-12	6	11	2	6
	(4)	10-8	6	10X	2	5
Cypress	(1)	6-18	7	8x	2	-
	(2)	7-10	6	12	2	5
	(3)	9-18	4	7×	1	5
Haemat	(1)	6-18	6	6	1	0
	(2)	8-5	6	2	1	0
Pond	(1)	6-10	15	Px.	3	0
	(2)	8-10	15	29	5	4
	(3)	9-25	13	12X	2	3
Phoenix	(1)	7-28	7	6	1	0
	(2)	8-19	7	23	4	8
Batey		8-6	3	4	1	0
1937						
Bambusa	(1)	6-10	15	9	2	5?
	(2)	8-2?	15	8	2	o
Old Gard.	(1)	7-6	12	9	2	O
	(2)	8-12	11	10	2	0
C3	(1)	6-16	1.1	10	2	o
	(2)	7-13	6	7	1	0
	(3)	8-16	6	14X	2-3	5
B2		8-13	7	3x	1	5
Gray	(1)	6-12	11	4	1	0
	(2)	7-10	11	10	2	5?
Wares		6-1	15	19	4	6

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the number of birds in the colony at the time the nest was built and the number of eggs laid; the number of laying females is calculated assuming that the number of eggs per female is between four and seven. This assumption finds difficulty only in the case of the B2 group, but in this instance it is possible that some of the eggs were laid on the ground and not found. Also, the fact that this was the second nest may have affected the number of eggs laid. In the case of the Ceiba group there were certainly two pairs and although one pair was greatly interested in the nest, the other paid little attention to it. In the Cypress group (2) there were three females but shortly after incubation started, one of them left, joined two males to form the Bridge group, and there laid four eggs. Hence, it seems necessary to conclude that two females laid a total of twelve eggs in the Cypress nest. The evidence from the Cypress group (3) proves that one female can lay seven eggs since there was only one female in the group. In summary, these data indicate that each female lays between four and seven eggs.

A female probably lays an egg every other day, but no group in which there was only one female was checked and the data showing the number of eggs laid on each day for a colony did not give a clue as to how often an egg is laid. The eggs may be laid at any hour of the day but are usually laid in the early hours of the afternoon. Eggs were laid before 7.00 a. m. and after 5.30 p. m.

Frequently the eggs appear to be in layers in the nest, each layer separated by leaves. Until the time of hatching the birds usually bring in a twig or leaf to the nest when they come in to incubate; this twig is placed on the nest and in time some of the eggs become covered up. If the nest is deep, most of the eggs can become covered and thus they are not warmed and turned regularly. Another method of forming 'layers' is that some of the females start to lay when the nest is no more than a platform of sticks, and in these cases drop the eggs to the side, where they become covered. These eggs in the lower layers do not hatch, although they are fertile and undergo some development. (No unfertilized eggs were ever found.) Usually the first eggs laid are covered, but it is not uncommon to find that by chance the last eggs laid are covered.

In connection with egg laying, a behavior of unknown significance was observed. The birds placed the fruits of a *Terminalia* (resembling a peach seed) in one abortive nest in which two eggs had been laid but subsequently knocked out.

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There is no special behavior before laying. The female goes to the nest without any performance. Sometimes a male is present in the nest tree. At this period the females have an enlarged abdomen for a few hours before laying and the excreta are very fluid.

#### VOUNG

The young, since they hatch at a late stage of development, are able to leave the nest in as soon as five days if stimulated by danger. At this time the young are excellent climbers, and whenever there is danger, scramble upward by means of the feet and bill. They frequently fall to the ground but, when placed in a tree, hop up at once.

As development proceeds, adult characters are assumed. The alarm call and the characteristic jerking of the tail are soon developed. The crest of the bill remains undeveloped for a long time, which distinguishes the young from the adults for about nine months. The outline of the crest is not as curved or as sharp as that of the adult.

The number of young which reached immaturity, that is, were able to feed and care for themselves, is about 24% (Table 5). In those nests whose history is known, 225 eggs were laid and 55 birds reached immaturity. Since, no matter how many eggs are laid in the nest, no more than eight eggs were ever found to have hatched, a correction is desirable. The total number of eggs above eight in each nest is subtracted from the total laid, giving 153 eggs which had a chance to hatch. Even with this correction the percentage is only 36.0. In comparison with other birds, the data Nice (1937) has tabulated for seven north-temperate passerine species shows that the average per cent fledged is 43.0. Whether the low survival of C. ani is normal in the tropics or is related to the abnormal nesting habits cannot be determined until studies are made on other tropical birds.

# PLUMAGE

The species has no regular molt, but loses the feathers throughout the year. Birds trapped at the height of the breeding season were found in all stages of loss of the remiges and rectrices. The contour feathers are lost mainly in the spring. Since the old feathers of the head are pulled out when the birds preen each other, the molt of the head is not apparent. The irregular loss of the tail feathers provides a convenient method of distinguishing the individual bird when it is possible to get a good view. Although it is easy to study the molt, since the old feathers are brown and the new ones contrastingly iridescent, the molt of an individual bird was not followed through the season.

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Albino individuals are occasionally found; in the famous Gundlach collection in Havana there are four birds of various degrees of albinism.

### ECOLOGICAL RELATIONS

In the locality where this study was made, the division of the year into a dry season from November to the middle of May, and a wet season for the rest of the year permits great differences in the behavior of the species. Since the dry season nearly eliminates the insect food and reduces the number of lizards, the judios are forced to subsist on vegetable matter. Individuals collected in April had fed upon the fruits of a palm (Roystonea) and the small seeds of several legumes. Little vegetable food is taken after the rainy season starts. As a result of the seasonal change, during the dry season the birds concentrate along the streams in an attempt to find insect food, but shortly after the rains begin the birds occupy the new areas as these become suitable for living.

The climate with its seasonal change is typically subtropical in its characteristics. The mean annual rainfall (1902-34) is  $52.42\pm1.8$  inches, most of which falls from June to November. The mean temperature for 1936 was  $25.1\pm1.1$  C. The temperature is also subtropical. For July 1936, it averaged  $27.2\pm2$  C., and for December it averaged  $22.7\pm2$  C. The temperature seldom is lower than 15 C. or above 35 C.

There is a relation between ecologic factors and the breeding season. Since there is so little variation in the number of hours of daylight during the year it seems probable that a change of food is the factor which initiates breeding. The evidence for the two years covered in this study suggests a correlation between rainfall in May and the beginning of nesting. The rainfall for May 1937, was 8.78 inches and the fields were green by June 1. Breeding behavior was first noted on May 16, but may have occurred earlier and not been recognized due to the inexperience of the observer at that time. The first eggs were laid on June 1, and several other nests had eggs on the 15th. Contrastingly, in 1938, the rainfall for May was 4.05 inches and the fields were brown on June 1, although excellent rains came the first week of June and the grass was soon green. The first indication of breeding occurred on May 20, the first eggs were laid on June 10 and other nests had eggs on the 18th. Although observations over a period of years are necessary for conclusions, these data suggest a tentative hypothesis that there is an internal rhythm which is modified within limits by the change of diet. Experiments designed to test

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this hypothesis were a failure due to the fact that the birds could not be taught to eat in captivity.

The breeding season ends before the diet returns to dry-season foods. A bird collected on November 15 possessed a regressed ovary and oviduct and the Cypress group (4) hatched its last young on November 5.

The ecologic conditions of the birds' habitat are quite definite. The birds require an open, savanna-like habitat, interspersed with a few trees to which they may rush at the approach of danger. In addition there must be a few thick, bushy trees in which to sleep. Since the number of suitable trees is reduced by the loss of foliage in the dry season, sometimes the birds have difficulty in finding a place to sleep. There is always a feeding area of open land, although groups may possess a territory containing woods and nest there.

In their relations to other animals, the adult birds have almost no enemies. Their wariness and their habit of going in groups does not permit any of the hawks to surprise them. Although the small boy with a sling shot is a constant source of danger, the birds seem to know the exact range and remain beyond it. The young birds are subjected to the vicissitudes of a nest life. For example, the nest of one group, situated in a heronry, was continually robbed, probably by the herons. Another nest was destroyed, probably by a rat. Accidents and disease result in the death of some birds. An individual which had probably flown into a sharp stick, and two diseased birds, were found. A bird with a broken leg disappeared in three days.

Although constant preening keeps the birds scrupulously clean, a few Mallophaga were found. Dr. F. H. Wilson of Tulane University identified them as *Esthiopterum macgregori* (Kellogg) and *E. crotophagae* (McGregor).

Crotophaga ani has almost no relations with other avian species. They fight with Ptiloxena atroviolacea (Icteridae) and, since the 'conk' is used in these cases, it is possible that the blackbird is mistaken for a strange judio. Although the only other species molested was Corvus nasicus, Falco sparverius is viewed with suspicion. Other species take alarm at the danger call and alarm note.

The ecological suitability of a habitat is roughly measured by the carrying capacity. The carrying capacity represents the number of individuals which can survive in a given area, and is dependent for most species on the amount of food and cover. The habit of living in colonies and possessing definite territories permits some significant

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observations on the concept of carrying capacity. In this species, although there is a great change in the number of birds in the colony, the same colony may own the same territory for a period of several years. Table 6 shows the changes in population from 1937 to 1938 and demonstrates that although the number of birds in the colony may change, there is not necessarily a change in the size of the territory. Consequently the territory habit is a fundamental factor in limiting the population and determining the carrying capacity.

TABLE 6

	CARRYING	CAPACITY	
Colony	Number of bi	Change in area	
	1937	1938	-
Bambusa-Pond	15-24	20-13	05
Old GCypress	10-13	7-5	none
C3-Gnhs	11-8	8_6	none
Cocos-Haemat	8-7	6	1
B2-Ceiba	7-8	9-3	1
Wares	10-0	6	none

# PSYCHOLOGICAL CHARACTERISTICS

The learning ability of *C. ani* is an outstanding characteristic. The birds soon learn that a man with a hoe or a scythe is a source of insect food and, although they fly up in alarm when a man walks along, the birds feed within two feet of a man at work or follow the gasoline mowing-machine. I was convinced that the birds recognized me as an individual but experiments to test this hypothesis were inconclusive. The birds were able to see me in the blind through the slits in the burlap used for observation holes, and one colony would not become quiet while I was in the blind.

Although the birds were excellent learners, they did not learn to eat non-moving food in captivity. A *Ptiloxena atroviolacea* was put in the cage and ate regularly, but the judios never learned.

In addition to the learning ability, the species demonstrates several releasers, as characterized by Lorenz (1937). Both the danger call and the alarm note are good examples. Each note is invariably followed by a definite behavior pattern. For the first call the birds fly downward and at the second they fly upward. One of the characteristics of a releaser is its improbability, such that the behavior pattern will not be set off by 'false alarms.' But the mockingbird has mimicked the alarm note, adding it to its territory song, with the result that the judios respond to the 'releaser' when there is no cause for alarm.

On one occasion the danger call was given when a decoy was put in the trap near the nest. The most likely interpretation of this event is that this was a time of extreme excitement and, since the danger call is at the apex of emotional excitement, it was given.

### DISCUSSION

Territory.—The concept of territory, as developed by Howard (1920) and others (Friedmann, 1933; Nice, 1933; Mayr, 1935; Tinbergen, 1936; Evans, 1938), has become a most fruitful generalization for the study of bird behavior. According to Friedmann (1935): "The theory of the function of territory is that it so spaces the breeding pairs of birds as to insure enough food for the young close enough to the nest so that, in their search for food, the parents do not have to desert the young long enough for any harm to come to the latter. In the spring the male leaves the flock with which it has spent the winter, isolates itself on an exclusive breeding territory to which area it confines its activities, makes itself conspicuous by display and song, thereby attracting a mate and at the same time warning other males not to trespass." Each species studied in detail demonstrates a large or small difference from the general behavior pattern.

The characteristics of the territory behavior of C. ani show clearly that the defence of the piece of land is the important feature. Sex is not a factor: the whole colony defends the territory against a strange bird no matter of which sex it may be. It is possible that there could be a colony composed entirely of one sex and this possibility should be tested experimentally. Food is not a factor: the territory is not defended in order to maintain the food supply in this species, because the same territory may be owned by a colony no matter how many are in the group; for example, the number in a colony changed from eleven to six, but the same territory was defended. Since Crotophaga has no song in connection with territory it may be concluded that song is not a necessary attribute of territory but is, in passerine species, a secondary acquisition. C. ani has definite behavior patterns for the defence and establishment of the territory and resembles the wren-tits (Erickson, 1938) and the mockingbird (Michener and Michener, 1935) in maintaining a territory throughout the year. The characteristics, cited here, show that the behavior is related only to a piece of land.

The defence of a piece of land, it is reasonable to assume, developed from the defence of the nest. Although Friedmann (1929) considers that the defence of the area originated first, Tinbergen (1936, p. 7)

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implies that the defence of the nest is primal. The nest is a tangible object which is always in the same place and can become the head quarters. For success in reproduction at least one member of the pair must defend the nest; other activities can take place almost anywhere. In various species the defence of the nest location is extended to other activities and in some species this enlargement is developed to such an extent that the same or a different territory may subserve any or all of the four main uses of territory, namely, mating, nesting, feeding of young, and winter habitat. This viewpoint on the development of the defence of the piece of land renders unnecessary the teleological implications of Howard, so decisively attacked by Lack and Lack (1933). This extension of the utility of the territory roughly parallels the development of the altricial nesting habit. Since this development is continuous there are intergrades between all variations of territory and there can be no rigid categories.

The defence of territory in *Crotophaga* has no teleologic motivation (i. e., the birds are not consciously *fighting for* any thing) but is merely an extension of the defence of the nest site. (The analogy of this extension to the development of an anatomical character, the crest on the bird's bill, is striking. This large crest has no function but is merely an hypertrophy of the bill.) It is true that territory has many functions (food, nesting site, etc.) but the teleologic interpretation of the behavior must be separated from the functional value of the territory.

The defence of the sex partner is a separate element, termed sexual fighting, and should not be confused with the defence of the nest and surrounding territory. Mayr (1935) emphasizes the factor of sexual jealousy and states that "territory was originally developed only in connection with mating. . . ." But the behavior of *C. ani* shows that sexual jealousy is not a factor in this species since many individuals live together harmoniously, and a stranger may join a group.

Definitions of territory have been attempted (Mayr, 1935; Tinbergen, 1936). Although a definition is difficult, the nature of the concept may be clarified by a short characterization of its main features. Territory is a stage in an evolutionary process and is a characteristic of a species. Dobzhansky (1937) points out the difficulties in trying to define a stage in an evolutionary process, in his case, a species. Despite these difficulties, territorialism may be described as the defence of an object (territory) which serves in reproduction. Several salient points in this description should be noted. The concept is con-

cerned with a behavior pattern in respect to a physical object. There is no mention of purpose nor of individual nor of sex. The word 'serves' is intended to eliminate those cases in which the fighting is in relation to sex partner. The concept is very inclusive and can include other vertebrates as well and is functional, not teleologic in its interpretation.

Breeding cycles.—Cycles, analogous to the estrous cycle of mammals, have been postulated by Howard (1929), Huxley (1932), and others. In addition Whitman (1919) refers to the 'synchronization' of the male and female. The study of C. ani has obtained data of the type which led to the development of these hypotheses. These data as outlined below are behavioristic and extremely difficult to control and to test experimentally.

One striking phenomenon is that a colony sometimes does not lay eggs until a new member joins. Thus, Wares group in 1938 consisted of seven birds (both sexes) until June 26 and did not show any indication of nesting, although other groups had already laid eggs by this date. On June 26, a new bird (sex unknown) was present (eight in the group), nesting behavior was first seen, and there were eggs probably by July 10. There were eight eggs in the nest, indicating that two females had laid. As another example of this phenomenon, the Ceiba group originally consisted of about eight birds and showed interest in several locations for a nest, but laid no eggs, although other groups had eggs by this date. On July 7, a male joined the group and incubation started on July 28. The group at that time consisted of two males and two females, only one of which laid in the nest.

A colony sometimes takes up a territory and builds an abortive nest but does not lay eggs and soon leaves the area. This sequence of events occurred in two colonies of five birds in 1938. A somewhat similar case occurred. The Haemat group built a nest and hatched six young which were destroyed by a small boy. During the rest of the season the group built three abortive nests and in one laid an egg which was knocked out of the nest. During this time the group decreased in numbers from seven to four. Since a pair may raise a brood, and since there is no correlation between the size of the colony and the initial date of breeding or its success, it is known that a large number of birds is not necessary for success in nesting.

Another characteristic of this species is that the number of days between the destruction of a nest and the rebuilding varies greatly.

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Table 7 shows that the interval between the date on which the nest was destroyed and the day the first egg in the new nest was laid, has no relation to the stage of incubation or feeding of the young and is not constant. In addition Table 7 shows that the time between the day the first brood left the nest and the date on which the first egg of the second brood was laid varies between 20 and 41 days and has

TABLE 7

		DAYS	BETWEEN BROO	DDS		
Colony	Adults at	Broo	d left	Days	First egg	Days
1937	second nest	first	second		second nest	
Bambusa	15	7-1	7-26	25		
B2	7	7-13	9-7	56	8-13	31
Wares	15	6-24	8-23	54		124
1938						
Wares	6	8-14	10-5	52	9-2	20
Pond	13	9-4	10-18	44	9-25	21
Cypress	4	8_8	10-18	71	9-18	41
Gnhs	6	9-5	11-5	31	10-8	33

no relation to the size of the colony. In this connection Nice (1937) has found that for the Song Sparrow (Melospiza melodia) the interval between the date a nest was destroyed and the day on which the young left the rebuilt nest was a constant (30 days) but that the interval between the dates the young left the nest in two successive broods varies between 30 and 41 days. The renesting after destruction in C. ani must be controlled by psychic as well as by endocrine factors. The destruction of a nest is comparable to an abortion in mammals and in that class it is known that after an abortion a female will come into estrous period in a definite length of time for each species no matter (except for the last few days) at what stage of pregnancy the abortion occurs. The Song Sparrow resembles mammals in that it produces young in a definite period of time. But in C. ani, factors other than endocrine seem to control renesting.

Other evidence indicating cycles, is that some variation in egg-laying ability occurs as is shown by the fact that not all females lay in the nest. In the Pond group there were thirteen birds in the colony and 29 eggs in the second nest (the first nest was inaccessible and was somehow destroyed), indicating that at least five females deposited eggs. The third nest had twelve eggs, showing that three birds at the most (probably only two) had laid. The size of the colony was reduced only by the loss of a male just after incubation had started

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in the third nest. Since it is known that the same female can lay more than once in a season, it is difficult to understand why some females stopped laying for the third brood. One suggestion is that different females laid in the second and third nests; but this solution does not seem likely from the history of other groups.

In addition to variation in laying ability great variation of interest in the nest is shown among individual birds. Individuals may leave the colony at the time incubation starts. For example, ARR (female) left the Cypress colony in which there was a male apparently paired with her on July 27; incubation had started on July 25. She formed a colony with two males, built a nest, and started to incubate on August 18. As another example a male (A432804) left the Pond group (incubation started August 29) on September 1 and joined with another bird. When this pair was collected on September 25 the female had an egg in the oviduct and the male had functional testes.

Furthermore, individuals vary greatly in their activity at the nest. In the Cypress group one pair did most of the work although two females had laid eggs in the nest and a bird which had laid eggs did not incubate at all but did feed the young. In two other cases eggs were laid but the nest was deserted without cause.

An additional point in support of cyclic breeding is that the strangers are most aggressive in their attempts to join a colony if it is in the nest-building stage, although they try to join a colony at any time.

The data cited above show that in respect to breeding behavior there is a difference of some sort between individuals and also a difference in the same individual at different times. Now let us examine the sparse knowledge of endocrinology of birds for any evidence of cycles within the season of reproduction. In the male the testis is always functional except during the incubation according to Schooley and Riddle (1938) and as soon as the feeding of the young stops the male returns to complete function. In the female the relations between the several hormones are inadequately known. The relations of prolactin to brooding and the possible inhibition of FSH (Bates, Riddle, and Lahr, 1937) occur after the eggs are laid and give no clue to the factors influencing egg laying. LH is present (Leonard, 1937) but its function is unknown. A type of corpus luteum is present but it is a rapidly regressing structure. This summary indicates that there is no positive endocrine evidence of a cycle in breeding.

Several features concerning the endocrinology of C. ani may be presented at this point. The history of the ovary is of interest. After

ovulation the granulosa layer proliferates and forms a structure considered by Hett (1923) as a corpus luteum, which decreases in size. In *C. ani* the corpus attreticum shows an interesting development. The granulosa of eggs which have not undergone pre-ovulatory swelling, proliferates and in *C. ani*, bursts, the yolk is apparently extruded from the follicle, and lymphocytes enter and take up the fat globules. After about ten days of atresia, this structure cannot be distinguished from a corpus luteum. The function, if any, of these two structures is unknown.

Another feature in reproductive physiology of C. ani is that throughout the season birds with small gonads occur. Birds of both sexes were collected at the height of the breeding season. A testis, which weighed one-sixth the normal, contained sperm, although these were not normally distributed, and had none of the characteristics of degeneracy. The ovaries contained eggs which are larger than in the juvenile, but had not reached the pre-ovulatory swelling stage. One explanation for these birds is that they are young hatched late in the previous season (November) which are still too young to mature sexually. Thus van Oordt (1938) has found that non-breeding Oystercatchers (Haematopus ostralegus) may be either yearlings or adults. The testes of the yearlings are somewhat developed and have a few sperm but those of the adults possess sperm and resemble those of breeding adults. The ovaries of yearlings are less developed than those of a non-breeding bird. This description agrees essentially with the histological picture of the gonads of C. ani. In addition, Kendeigh and Baldwin (1937) find that about 15% of the young House Wrens did not breed in the first year, and Lorenz (1931) finds that young Jackdaws court and pair in the first autumn but do not breed till the second year. Another explanation of the condition of the gonads of these specimens is that they are "old virgins," as described by Schooley and Riddle (1938). According to these authors, these birds have ovaries which "have developed somewhat beyond the juvenile state, but no ova have entered upon the final phase of growth which is induced by a release of increased amounts of pituitary gonad stimulating hormone." The basophiles of the pituitary are undifferentiated and agranular and are smaller than pre-ovulatory basophiles. The acidophiles are nearly normal and resemble those of nesting birds. Although the pituitary resembles that of a senile animal, it is known that these birds are no more than a year and a half old. This condition is essentially pathologic and would not be expected in a natural population.

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In reproductive physiology the problem of the factor which determines the cessation of laying in birds is important. Presumably either visual or tactile stimulation reacts through the pituitary to stop the laying process. But since in *C. ani* more than one bird lays eggs in the nest, there is a varying number of eggs, and hence neither sense can be effective. In this connection it is interesting that incubation starts slowly and is intermittent for a few days although most species start abruptly and sometimes before the eggs are laid or the clutch is completed. The fact that incubation starts simultaneously although the eggs may be laid over a long period of time (16 days in the Pond group) and presumably some of the females have completed their clutch suggests that the psychologic factors may be more important in arresting laying than any endocrine factors which may exist. The great variation (4–7) in the number of eggs laid per female may be related to the lack of a suitable stimulus to stop laying.

The hypothesis of Darling (1938) pertains to some of the apparently cyclic behavior seen in *G. ani*. Darling suggests from his work on the breeding of gulls that the birds must be stimulated by courtship to a high degree of emotional excitement before breeding can begin and that in colonial birds there is a great amount of reciprocal stimulation within the flock and hence a minimum number (threshold) of birds is necessary before the breeding can start. Therefore, in colonies where the number of birds is just above the threshold, the breeding is irregular and the number of unsuccessful nests is high. Darling's observations on which he based the above hypothesis can also be explained by the hypothesis of reproductive cycles. In the large colonies, since there are more birds, there is a greater chance of one bird meeting a bird in exactly the same phase with it and therefore in the large colonies there will be a greater success in breeding. Neither of these hypotheses is supported by experimental data as yet.

A last item concerning the relation of the endocrine system with the behavior is the problem of the incomplete nests, here termed abortive. These have been regarded as 'symbolic nests' (Tinbergen, 1935), the building of which results in sexual stimulation of the mate. But the fact that in *G. ani* many abortive nests may be built after pairing, after copulating, after laying, and even after a nest has been destroyed suggests that these nests are abortive due to a maladjustment of the endocrine and nervous sexual mechanism, and are not stimulative in effect. Tinbergen found that 'symbolic nests' were built after coition and hesitatingly suggested that the function was to keep the pair

together. The 'play nests', built by male wrens which have a mate and eggs, are in a different category.

Parasitism.—C. ani is a member of a family, the Cuculidae, which has developed social parasitism in many species. The genus Crotophaga shows one manifestation of the unusual breeding habits developed throughout most of the family. These various abnormalities may be described as a lack of coordination in the sequence of breeding habits, but this description, of course, does not explain anything.

In order to understand the genus Crotophaga it is necessary to discuss briefly the types of social parasitism found in birds; Friedmann (1929) and Makatsch (1937) give references to the extensive literature. I suggest that parasitism has developed along two lines: (1) Nest parasitism, where one group of species, probably in relation to a loss of territory instinct (Friedmann, 1928), no longer builds its own nests but lays eggs in the old nests of other species and raises the young in a normal manner. The fact that in most cases the species (Icteridae, Ploceidae) are closely related to the birds whose nests are used, may be explained by the similarity of breeding habits and ecological requirements of the birds. In other cases (Legatus leucophaius, Tringa solitaria, Zenaidura macroura) the birds use the nests of non-related species to a greater or less degree. The evolution of parasitism followed from this behavior in various stages. The birds usurped a nest and laid eggs before the owner had used it. The species soon developed the habit of dropping eggs on the ground or laying them in the nest and leaving them, probably often due to competition with the owner. Thus complete parasitism occurs. Some of these species are originally host-specific, but it should be noted that in the Cowbirds the host specificity has decreased to such an extent that in the case of the North American Cowbird, the eggs are laid in nearly any nest. The loss of the nest-building instinct is the cardinal feature in nestparasitism development.

The other line is (2) egg parasitism. In this development the bird does not usurp the nest, but lays eggs in other nests, more or less haphazardly as is done by pheasants and ducks. Nevertheless in addition it regularly builds its own nest and raises young in a normal manner. In the case of *Heteronetta* this behavior has culminated in complete parasitism. It seems likely that the Cuculidae (for example, as in the North American cuckoos) at first deposited the eggs in nests other than their own while still building nests and raising their young (Herrick, 1910). Then they became more parasitic and eventually

lost the ability to build a nest. It should be noted that in the cuckoos the trend has been from parasitizing many species to parasitizing only one species (host-specific), and that the territory instinct has been retained. The loss of the instinct to raise young is the cardinal feature of egg-parasitism.

A possible explanation of the loss of the instinct to raise young is found in some of the work on the pituitary. Byerly and Burrows (1936) have shown that the pituitaries of non-breeding fowl contain less prolactin than those of broody races. If prolactin produces brooding, as Riddle, Bates, and Lahr (1935) claim, it is possible that birds, non-broody due to a loss of prolactin or a loss of reactivity to prolactin, have been able to survive due to the parasitic habit.

The peculiar breeding habits of Crotophaginae seem to be an off-shoot of the egg-parasitism line. This suggestion as to the evolution of behavior is supported by what little is known of the habits of Guira. This bird is reported to lay eggs in the nests of C. ani and certainly deposits its eggs in the nests of other species (Phytotoma, Milvago). The birds drop many eggs on the ground and although laying their eggs in other individuals' nests, do not usurp the nest. It may be considered that C. ani has become host-specific on itself, and that the territory instinct has been retained and extended to include other individuals of the species. In contrast to this view Makatsch (1937) believes that Crotophaga in not an offshoot but is a step between the habit of laying occasionally in other birds' nests and the full development of parasitism.

The cause of the aberrant breeding behavior is unknown but the following hypothesis is suggested in the hope that it may have heuristic value. There are several examples of one organ assuming the endocrine function of another. I suggest that in those birds in which the behavior is hormonally controlled, it is possible that the pituitary has adopted the control of breeding behavior from the gonads and that the change is either incomplete or partly miscarried, resulting in erratic breeding habits or complete loss of some phases. Parasitism or social nesting has permitted these species to survive.

It is perhaps more than coincidence that in *C. ani* the nesting is so erratic and so often miscarried and the courtship display so simple and infrequent. It has been suggested (see Marshall, 1936) that the function of courtship display is to synchronize the sexual processes of the male and female. That courtship may act on the endocrine system is supported by the fact that Schooley and Riddle (1938) have

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shown that the absence of a male pigeon results in changes in the pituitary of the female. This chain of evidence supports the suggestion that aberrant breeding habits are connected to dysfunction of the endocrine system.

Comparison with Social Birds.—True social life in animals has developed coincident with an extension of the familial relations over the greater part of the life span of the individuals. In C. ani the young of one brood may feed the young of the second brood but it seems likely that this action is a secondary development. The social habit, permitting the young to remain with the adults for a long time, is found in incipient stages in several birds. Skutch (1935) cites examples of species (Psilorhinus mexicanus, Psaltriparus melanotis, Heleodytes zonatus) in which unmated birds help in the raising of the young. In the species Psilorhinus mexicanus immature birds brought food to the incubating female. There were presumably no familial relationships among the birds. In C. ani, some of the non-breeding birds are probably immature.

Other species seem to have independently developed the same habits as C. ani, although not enough is known of their habits to compare them in detail. In Corcorax and Pomatorhinus (Friedmann 1935) available information indicates a development of social nesting. In Balanosphyra (Ritter, 1938) there is a social nesting behavior which closely resembles that of the judios. These woodpeckers live in groups and probably defend a territory for the whole group, judging from reports of fighting and flights within the territory. Birds whose actions resemble those of the strangers of C. ani are described. Seventeen eggs are reported from one nest and the conclusion is that several females laid in this nest. This is most surprising since the woodpeckers as a group are very normal in their breeding habits.

The Jackdaw (Lorenz, 1931) has developed a type of social behavior which has only a superficial similarity to the habits of *C. ani*. The birds live in a group but nest in pairs and observe strict monogamy. Strangers are not permitted to join except in the winter, and the loss of a member of the flock is noticed. In this species there is no abnormality of the breeding sequence. Other species have a social habit to a greater or less degree such as is illustrated by the grackle, *Cassidix* (McIlhenny, 1937). The females are in great excess and the males are polygynous. The male selects an area and drives off all other males in order to collect a group of females, but takes no part in the raising of the young. In these species there is no abnormality of the breeding sequence.

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The social habits of the howling monkey have been carefully studied (Carpenter, 1934), showing some interesting similarities to the judios. There is a disparate sex ratio in each group, in favor of the females, however. Single individuals may join a group after fighting, much as strangers join a group of anis.

Social habits may develop readily in a species which has poorly coordinated or irregular breeding habits. The irregular breeding habits permit the presence of non-breeding birds and of an excess of males in the population to result in social nesting labits and in the extension of territorial instinct to include the whole colony. The manner of development of social nesting in *Crotophaga* should be clarified by a thorough study of *Guira*.

In the development of social habits a species acquires many releasers and other behavior patterns of the type described by Lorenz (1937). For *C. ani* the data on this subject are so unrelated that their presentation is reserved for a future time. Nevertheless two social characteristics may be mentioned. In *C. ani* the sense-modality used in sex recognition is probably sight. In some species (Noble, Wurm, and Schmidt, 1938) voice is extremely important while in others sex is recognized by visual cues (Noble and Vogt, 1935). In judios the method of sex recognition is difficult to determine because of the antagonism to strangers. Experiments using dummy birds proved nothing, and the behavior at copulation gave no clue to the sense-modalities used.

The other social characteristic to be mentioned is that probably there is a dominance of the flexible type found in most birds (Allee, 1936). The colonies of *C. ani* live so harmoniously that it was impossible to conclude that there is a strict social rank.

## SUMMARY

Crotophaga ani, an aberrant member of the Cuculidae, lives in flocks and builds communal nests. Each colony defends a territory against strangers, which are of two types: one tries to join the group and the other does not. The defence behavior consists of 'chasing' the strange individuals and 'rushing' from tree to tree.

The pairing and nesting behavior occurs in five distinct stages. The behavior sequence is frequently interrupted and is often irregular. The relationships between the adults are in some cases certainly monogamous, but in other cases, the relationships may be either polygynous or polyandrous.

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The nest contains the eggs from several females, each female laying between four and seven eggs. The incubation period lasts about thirteen days. The survival of the young is about 35%. The young birds remain with the flock for many months and assist in feeding the subsequent broods.

The climatic change from a dry to a wet season permits great changes in ecological distribution, and regulates the initiation of nesting.

The data concerning *C. ani* indicate that (1) the defence of a piece of land is the crucial factor in territorialism. (2) The breeding behavior is in some manner cyclic or at least variable. (3) The aberrant breeding habits are an offshoot of the egg-parasitism type of social parasitism.

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# OBSERVATIONS ON HERRING GULL SOARING

BY ALFRED H. WOODCOCK

For sustained soaring flight the Herring Gull (Larus argentatus smithsonianus) makes use of two types of air motion. The first type is caused by obstructions in the path of the wind (ships, the sea surface, a land mass) which deflect the air upward and cause sharp velocity gradients in the flow. Soaring under these conditions is here called obstructional-current soaring. The second type of air motion used by the soaring gulls is caused by a condition in which colder air overlies a warmer under surface. When cold air overlies warm water, the air near the water is heated. When this heating produces a falling-off of temperature with height, in excess of the adiabatic change, instability occurs, and any vertical displacement will start the warm air moving upward. This air motion is here called convection flow, and soaring therein is referred to as convection soaring. It may be added that the frictional influence of the sea surface in retarding the flow of air over the water, when inter-related with waves, produces a condition which makes another type of obstructional-current soaring possible. This soaring response, used by shearwaters, gannets and albatrosses, will be discussed in a subsequent study.

A search through the available literature on gull soaring, has failed to reveal any indication that other observers have noted the following significant points: (1) the strength of convection over the open sea along our eastern seaboard; (2) the importance of this convection in influencing if not controlling the sea economy of the birds; and (3) their reluctance to use wing-flapping flight whenever soaring conditions obtain. The purpose of this paper is to discuss the observations which have led to the formulation of these points, and to suggest further problems which have arisen from them.

The sea observations that follow, were made between latitudes 16° north and 42° north, and within six hundred miles of the eastern coast of North America. They are a result of many cruises on board the research vessel 'Atlantis,' extending over a period of about two years. The 'Atlantis' affords an unusual opportunity for watching seabirds, for the vessel often spends many hours, and sometimes days, on one location. The shore observations were made on Cape Cod, Massachusetts, at or near Woods Hole.

Along our eastern seaboard during the winter, there is an almost continual movement of cold continental air out over the warmer sea,

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resulting from the prevailing westerly winds in this latitude. The temperature differences between the air and the water cause convection currents in the air which vary in strength, depending upon the magnitude of the thermal differences, and upon the speed of the wind. The Herring Gulls indicate the existence and the strength of these convection eddies in a type of soaring response which I have called convection soaring. This type of soaring is invariably associated with situations in which the water is warmer than the air, and becomes impossible when the air temperature rises above that of the water.

Horton-Smth (1938) has classified gulls as 'low-soarers,' with wings of 'high aspect ratio' ill adapted to soaring in ascending currents. Despite the fact that gulls' wings are poorly adapted to high soaring, we, on the 'Atlantis,' must often resort to binoculars in order to follow their soaring ascent in convection currents. This seems a clear indication of the great strength of this sea convection.

Headley (1912) has stated that "at sea, in our northern latitudes, there are no up-currents . . . sufficient to make soaring possible." He was speaking about convectional "up-currents." 'Atlantis' observations give a decidedly contrary view. In a 28-miles-per-hour surface wind, with a five-degree Centigrade difference between air and water temperatures, we have seen Herring Gulls soaring directly to windward, and at the same time rising rapidly. Considering the fact that the wind velocity usually increases with height, and also, estimating the gulls' windward motion (relative to the vessel hove-to) as ten miles per hour, it seems fair to assume that these birds must have had an air speed of forty miles per hour, or more. Assuming a three per cent angle of descent, which Idrac (1923) used for albatrosses (this angle is probably too low to apply to gulls), we find that the estimated horizontal speed of these birds would require an up-motion in the air of about one and two-tenths miles per hour. But these birds gained altitude as they moved to windward! This must mean that the convection up-flow of the air under these conditions was considerably greater than that required to maintain the birds in position and in altitude.

Two years of recording the distribution and number of Herring Gulls seen far (over fifty miles) at sea, have suggested that the birds do not venture far from shore until the cold continental air of the late autumn assures adequate convection action as it flows out over the warmer sea. This idea is further supported, when we consider

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that there is a three-month interval between the time when the birds are finished breeding, at the end of July, and the time when they are seen far at sea.

During periods when the air temperature closely approaches or exceeds the sea temperature, Herring Gull flight is invariably labored. Soaring under these conditions seems impossible, save in the obstructional currents off the ship's sails. The comments of Dutcher and Bailey (1903) about the "marked evidence of fatigue" of Herring Gulls upon returning to their breeding grounds from daily sea trips, are entirely in agreement with our observations. Along the New England coast during the late spring and most of the summer, the air is often much warmer than the sea. Under such conditions the birds must flap their wings continuously.

In August 1938, while the 'Atlantis' was anchored about thirty miles east of Highland Light (Cape Cod), we saw Herring Gulls making daily trips to the fishing grounds to the east. In the early morning all of the birds were flying eastward; in the late afternoon all of them flew landward, into the setting sun. During these two days there was never an exception to the labored, wing-flapping flight. Warm air over cold water means hard work for the gulls.

Even during mid-winter off our coast, there are times when warm air masses coming from the southwest practically 'ground' the Herring Gulls until colder air moves in. During the 'Atlantis' cruise to Bermuda, January 4 to 11, 1939, there were two such periods. On January 5, we were in a high-pressure area, and the air was six degrees Centigrade colder than the water. The gulls were in the air soaring during the whole of the day. The evening of the 5th, a warm front passed us, bringing in a mass of air which was warmer than the surface water. This warm air remained with us on the 6th of January, and all of the gulls were either sitting on the water about the ship, or riding the obstructional-current up-drafts off the mainsail. On the 7th, the wind changed to a cold northwester, starting convection currents which all of the gulls immediately began to use in soaring flight. On the 8th, the cold air continued over us, and the soaring was magnificent to see. The wind had risen to 28 miles per hour, which seemed only to increase the rate of convection and the ease of soaring. Late on the 9th of January, another warm front passed, and during the whole of the 10th and 11th the gulls were 'grounded,' or beating their way laboriously about on flapping wings.

During the periods when an air mass warmer than the water covers

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the sea, the gulls seem very reluctant to expend their energy in fighting the unfavorable conditions. Most of the time they sit on the water and wait for a change in the weather, rising into the air on flapping wings only when they come near our vessel for food.

As a means of conserving energy, the gulls will often use convectional and obstructional currents alternately. This they do on shore as well as at sea. During the spring, when the herring are running up the streams of the Cape, the gulls move inland following the fish. As solar heating sets up convection currents over the land, the gulls may be seen swinging inland on these currents from their roosting places along the shore. The prevailing southwesterly winds, pouring over the irregular terrain of the inland region, furnish many up-flow areas on windward slopes near the streams. The gulls glide down from their passing convection eddies on to these obstructional up-flow areas, and in these areas they can soar easily up or down stream in the course of their fishing.

At sea, gulls riding the up-drafts off 'Atlantis' sails are often seen to change over to convection-current soaring, but not without obvious searching for the convection eddies on flapping wings. When a convection up-flow is found, the birds must lift themselves fifty, a hundred, two hundred feet, depending upon the strength of the up-flow and of the wind, before the rising rate of the air exceeds their own settling rate, and they are able to begin soaring. However, they detect the presence of the convection when they are flying just a few feet over the sea surface, for one sees them change abruptly from a wing-flapping horizontal flight to a steep climb, before they start the flying tactics characteristic of convection soaring.

The efficiency of convection soaring in helping a bird to maintain its position in relation to some area of the sea, or in making it possible for it to move about easily, depends upon the relative air and water temperatures, and upon the wind velocity. The optimum conditions for convection soaring seem to obtain when the air is over five degrees Centigrade colder than the water, and the wind speed is between twenty and thirty miles per hour.

The habit of gulls in changing readily from the obstructional upflow areas of a ship to convection eddies, and then back again, suggests that they may use this method to move rather easily from the favorable eddies of one ship to those of another. Thus they might change from ship to ship in their continual search for food. Many times gulls are seen arriving over 'Atlantis' from the two windward quadrants; uk

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sometimes high in the air and still in a convection up-flow, sometimes lower, and in a straight glide.

The reluctance of gulls to waste their energy in opposing unfavorable conditions, is seen on shore as well as at sea. From a steep air slope over a windward embankment on Juniper Point (Woods Hole), the gulls can get enough altitude in a sixteen-miles-per-hour southwest wind, to enable them to glide directly to windward four-tenths of a mile to a roosting place off the northeastern tip of Nonamesset Island. It is amusing to note that, upon failing to reach the roosting place on the first trial, the birds will return to the region of the up-flow (while they still have enough altitude for the quick down-wind glide), rather than flap their wings for the last few hundred feet of the flight. Apparently several minutes of extra soaring time are preferable to a few seconds of wing-flapping.

Inexplicable changes in flight tactics, which accompany physical changes in the air and water at sea, have led me to think that meteorologists might learn much about the motions of air flowing over the sea surface, by watching the flight evolutions of seabirds. In the waters off our coast we have, at various seasons, three kinds of seabirds which use three very different flight methods. These three kinds of seabirds normally inhabit three different bands of air: Wilson's Petrels, the first few feet of air over the water; shearwaters, the first fifty feet of air; and gulls, the first thousand feet, or more. The different flight characters of these birds are a reflection of the normal air motions in their respective bands of air. It seems reasonable to suppose that a study of the changes in the flight tactics of these birds, in response to changes in the physical characteristics of their particular air strata, would reveal much of the nature of the air motion in the different strata.

A particularly obvious problem in air motion has arisen from these observations of the flight movements of gulls. Why is it that Herring Gulls, convection soaring in winds below fifteen miles per hour, must circle about as they rise, being carried along down wind all of the time; while in stronger winds of eighteen to thirty miles per hour, they can soar straight into the wind, gain altitude, and move rapidly to windward? Some very significant change takes place in the form of the convection eddies between the wind velocities of fifteen and twenty miles per hour.

Perhaps the system of 'helical vortices' which Langmuir (1938) found developed, under the influence of the wind, in the surface

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waters of lakes, also develops on the surface of the open sea, as Langmuir has suggested. The flight tactics of gulls sometimes suggest that this system of helical vortices in the water has its counterpart in the air over the water, and that increasing wind velocities cause an extension of the system higher and higher into the air.

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# FURTHER STUDIES OF THE GENUS QUISCALUS

### BY FRANK M. CHAPMAN

In my preceding 'Auk' papers¹ on the genus Quiscalus, I treated of the grackles of Louisiana and Mississippi. From those States, thanks chiefly to the cooperation of Mr. E. A. McIlhenny, I have had a sufficient number of breeding males to warrant an attempt to define their ranges and relationships.

Reviewing briefly the theories advanced and results obtained: early in the history of what is believed to be their post-glacial rangeextension from Florida and Texas respectively, Stone's and the Bronzed Grackles first met in southern Louisiana and completely merged by interbreeding. The area of intergradation in the State named now averages forty miles in width. North of this zone, which here trends east and west, only aeneus2 occurs; south of it, only stonei and the Florida form, from which it appears to have descended, are found. In the narrow band separating the two typical primary parental forms, complete intergradation occurs. Sometimes this phenomenon is found in a single colony. The relationships of the birds under these conditions seem clear. As we enter Mississippi the problem becomes more complicated. It will be found treated in the fourth of my 'Auk' papers. Here I wish merely to state that the first papers in this series treated of the birds concerned in the most southern area of their intergradation, while in the present paper I consider them in the most northern area of their intergradation.

With the passage of time aeneus has extended its range northward through the interior to Slave Lake and from the upper Mississippi valley has swept eastward through New York on a front which now reaches from the lower Hudson valley eastward and northward; while stonei has ranged northward through Cis-Alleghenia to the northern limits of the Carolinian Fauna, including Long Island and the Connecticut valley. As we try to picture the original grackle invasion of this territory we must remember that by no means all of the newcomers were typical of either stonei or aeneus. The study of adequate material from Louisiana, and particularly Mississippi, has given us some conception of the character of the grackle population at the junction of the western with the eastern form. In this area of intergradation pure-blooded individuals are comparatively rare while intermediates

<sup>&</sup>lt;sup>1</sup> Vol. 52, January and October, 1935; vol. 53, October, 1936; vol. 56, January, 1939.

<sup>&</sup>lt;sup>3</sup> For a discussion of the correct name of this bird see Chapman, 'The Auk,' 56: 564. 1939; and Wetmore, ibid., p. 505, 1939.

of mixed blood prevail. As the birds extended their range northward this prevalence of intermediates doubtless continued to mark the area of contact. If this supposition be true it follows that a proportion of the original grackle settlers in the area to which we are here devoting our attention must have been the progeny of aeneus and stonei and their variants.

Furthermore, without making an attempt to explain the origin of the habit, the fact remains that pure aeneus is a regular spring and fall migrant, in large numbers, through the territory of stonei. It is therefore more than probable that late spring migrants of aeneus occasionally stop in the northern part of the range of stonei and breed with that form as they usually, if not invariably, do wherever their breeding ranges meet. We have, therefore, a widespread territory where the northern limits of stonei meet the southern limits of aeneus. and well within which northbound migrants of the latter doubtless breed with the former. These conditions have been operative over an unknown period and their cumulative results are correspondingly confusing. In the region concerned I have found no stations occupied exclusively by pure stonei. Even where that form reaches its full development, specimens occur which show some trace of a remote contact with aeneus. But in spite of this irregularity we shall find, I think. that a pattern has been formed which contains for us a lesson in the making of species. Meanwhile, in making available the data I have acquired, I can at least serve the ends of local identification and acknowledge the generous cooperation of my colleagues.

I proceed now to an examination of the specimens, most of which have been collected in the past two nesting seasons, in the area under consideration. With the object of basing this study on breeding males I have used only specimens taken from May 1 to June 15. The resulting short collecting season, added to the difficulty of finding breeding colonies of these highly local birds, has made it impossible to cover even a limited region thoroughly and the inadequacy of my collections will soon be observed.

At the risk of repetition, which I should prefer to call confirmation, I again briefly examine the status of the two forms whose intergradation has produced *ridgwayi* and its subsequent variants. With aeneus we have no difficulty. In its own territory, from southern Texas to the limit of trees, it is always aeneus. Few wide-ranging birds are more stable. Only when, from Louisiana to Connecticut, its range meets that of stonei, does it depart from type and by interbreeding with that form, produce the bird we know as *ridgwayi*.

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Whether aeneus is a species or a subspecies is a question I will not discuss here. It assuredly differs from stonei in external appearance more than do many unquestionably distinct forms from each other. On the other hand, the sexual relations of aeneus with stonei are certainly not those that we expect to find between species. Wherever, when breeding, the two meet, stonei accepts aeneus and aeneus accepts stonei with a unanimity which results in their complete fusion and the production of offspring presenting the characters of both parents. This is the first stage in the creation of the "Purple" Grackle complex; that is, a combination, in endless variety, of aeneus, ridgwayi and stonei. To consider these birds in their physical and geographic relation to one another and their environment is the chief object of this study.

Compared with that of aeneus the case of stonei is not so clear. Additional material and further study strengthen my belief that this form has originated by mutation from the Florida Grackle. The change from that species to stonei is apparently not associated with environment and it is completed before the range of aeneus is reached. So far as existing conditions go, therefore, neither aeneus nor its descendants plays any part in the making of pure stonei. Whether we follow the nascent form from Florida westward to southern Louisiana, northward into Alabama or northeastward to New Jersey and Long Island, it passes through essentially the same stages of development and reaches the same end. A series of stonei from Louisiana can be duplicated by one from New Jersey.

We go now to Florida in search of the origin of *stonei*. Although the Florida Grackle is the only one of the group in which the head is practically constant in coloration, it is, when compared with *aeneus*, a fairly variable bird. The Bronzed Grackle, as we have seen, through its vast range, presents no constant variation except where it meets *stonei* or their intermediates. But among Florida Grackles individuals are not infrequently found which, in varying degrees, differ from the prevailing type.

The taxonomic ornithologist attributes such departures from type to 'individual variation,' which he expects to find in most large series of birds. By the geneticist these variations, when heritable, are termed 'mutations.' They supply the stuff of which, under favorable conditions, new species are made.

Typical Florida Grackles (Quiscalus quiscula quiscula) have the foreback uniform bottle-green, but, on raising the feathers, a faint

iridescent band is found at the base of the broad green tip. It is the growth of this band that constitutes the first observable evidence of variation. In a series of 52 males from the Florida peninsula, nine from seven localities have this band so well developed that it may be seen without lifting the feathers, and in two of these nine birds (Pine Island, Florida, February 10, 1888—F.M.C.; Jupiter, Florida, January 2, 1920—L.C.S.) the back is barred and the feathers tipped with purple. These birds are nearer stonei in body color, than they are to the Florida race, and in this respect, they can be nearly matched by specimens from southern Louisiana and also New Jersey. In the color of the head, however, and in size and shape of the bill they agree with the Florida bird, indicating that they are not migrants from the north. Indeed, I have yet to see a northern grackle from Florida.

It seems, therefore, that within the heart of its range, the Florida Grackle exhibits potentialities which, under favorable conditions, may develop into stonei. These conditions, which doubtless include partial segregation and new associations, have apparently been found as the bird extended its range from Florida and entered territory before unoccupied by its kind. Thus, removed from the dominating influence of a population overwhelmingly pure quiscula quiscula, variations have been perpetuated and in time and space stonei has become established. We may imagine history repeating itself when we find that of six grackles from Grady County, Georgia, near the Florida boundary, only four are typical quiscula while one exhibits the mutant characters shown by the Pine Island bird above mentioned, and one has the green-blue head so frequently found in northern birds, but never in true quiscula.

Our specimens from west of Florida have been recorded in my earlier papers. Here I will state only that of nine specimens from Greensboro, Alabama, four are half way between quiscula and stonei and five are stonei; of ten from Lucedale, southern Mississippi, one is quiscula, seven are intermediate toward stonei, and two are stonei; while of 27 from Avery Island, southern Louisiana, one is quiscula, 15 are stonei and 11 are between the two.

Northward from Florida to New Jersey, my data are very incomplete. Descendants of the Florida bird range northward through Alabama apparently to eastern Tennessee whence *stonei* has been recorded from Rockwood in the Tennessee Valley and from Washington County still farther north. From Johnson County, in extreme northeastern Tennessee, Dr. Wetmore (Proc. U. S. Nat. Mus. 86: 231,

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1939) records a specimen of ridgwayi showing that we are here within the influence of aeneus. In West Virginia this influence is more pronounced, though pure stonei still occurs. Our collection contains two specimens of ridgwayi and one of stonei from White Sulphur Springs and Mr. J. Lloyd Poland sends us specimens from eastern West Virginia as follows: Monroe County, three ridgwayi; Greenbrier County, one ridgwayi; Berkeley County, one ridgwayi, one intermediate nearer stonei; Jefferson County, one stonei. From Lewis County, in the north-central part of the State, a single specimen of pure aeneus suggests that we are near the boundary of the range of that form.

We follow now the more direct route of the Florida form and its derivatives northward through the Atlantic States. Georgia, as possibly free from the influence of aeneus, should have an interesting story to tell, but unfortunately, except the Grady County birds above recorded, I have no specimens from that State. Along the coast the Florida form extends at least to Charleston whence I have seen nine specimens, all referable to quiscula; one, however, has the head greenish blue as in many specimens of the Bronzed-Purple group. From the rest of South Carolina, and from North Carolina, we have no material. Four specimens in worn plumage from Newport News, Virginia, are apparently between quiscula and stonei but additional and better material is required to determine the status of the grackles of this district.

The National Museum collection, Dr. Wetmore reports, contains two May males between quiscula and stonei, four stonei and one ridgwayi from the District of Columbia. From Worthington Valley, Baltimore County, Maryland, we have two stonei, two ridgwayi and two intermediates. A single specimen of stonei from Jefferson, Frederick County, Maryland, in connection with our West Virginia records, suggests the occurrence of that form in Pennsylvania west of the Alleghenies.

The capture of two specimens of *stonei* and one intermediate toward *quiscula* in Cecil County, Maryland, northeast of the head of Chesapeake Bay, arouses a special interest in the grackles of eastern Maryland and eastern Virginia which may be removed from the influence of *aeneus* derivatives by the waters of Chesapeake Bay. Possibly also, we may find there the northern limits of pure *quiscula quiscula*.

We now enter the southern limit of what may be called the New York region, which I have previously defined as including the northern

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limits of stonei and the southern limits of aeneus. The accompanying table lists all our presumed breeding males from this grackle 'melting pot.' Note that with the exception of one specimen from Old Westbury in western Long Island, no intermediates between stonei and quiscula have been found north of Princeton, New Jersey.

An April 23 bird from Penns Grove, New Jersey, is practically quiscula quiscula but has the head bluish green. Ten specimens from Princeton are almost equally divided between stonei and ridgwayi and their intermediates in both directions; thus, from the same station, we have specimens near quiscula quiscula and also near aeneus, an unusual association. From Rye, New York, on the Sound near the Connecticut line, our series contains specimens of both typical stonei and aeneus and all the stages between them.

Proceeding northward up the Hudson and northeastward into New England we will, in due time, enter the territory of pure aeneus where evidences of its contact with stonei are unknown. Crossing to Long Island, which has claimed our especial attention, we encounter an exceptional environment which apparently has produced highly significant results. Here, in extending their range, grackles have entered a partially insulated region removed from direct contact with pure aeneus and nearly out of touch with stonei. In western Long Island we are still within the area of the 'melting pot.' Thus of twenty specimens from Oyster Bay, four are stonei, four intermediates toward ridgwayi, seven ridgwayi and five intermediates toward aeneus, one of which, indeed, is almost aeneus. As we proceed eastward we find a pronounced increase in the numbers of ridgwayi, with a corresponding decrease in the numbers of other forms. For example, from Jericho seven of eleven, from Plainview seven of twelve, and from Central Islip eight of eleven specimens are ridgwayi.

Without at least ten specimens one should not attempt to determine the grackle complex of any one station. I therefore leave the presentation of further local details in Table 1 in the belief that the facts I wish to emphasize will be more impressively shown in this summary. The decrease in stonei and increase in ridgwayi on Long Island are the significant features of this comparison. The latter, with its intergrades toward aeneus, number, indeed, 65 out of a total of 72 specimens, as compared with a total of 11 out of 46 in New Jersey, thus showing to what extent the ridgwayi type prevails in eastern Long Island. In view of this fact it may well be asked, if ridgwayi is the offspring of aeneus and stonei, how do we account for its presence where

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TABLE 1

	Florida Grackle No. 1	Intermediates	Stone's Grackle No. 2	Intermediates	Ridgway's Grackle No. 3	Intermediates	Bronzed Grackle No. 4	Total
New Jersey and Staten Island		5	19	11	8	3		46
Eastern Long Island			3	4	48	17		72

one parent is unknown and the other comparatively rare? The condition which inspires this query is emphasized by the occurrence of aeneus and ridgwayi and complete absence of stonei on the island of Nantucket, showing that ridgwayi may exist with only one or the other of the original parents. From this stage it is but a step to its existence without either of the original parents. The conditions favorable for this step are evidently provided by the partial insulation found in eastern Long Island where, in my belief, it is only a question of time when ridgwayi will be the only form of grackle regularly breeding there. In this connection it should be remembered that aeneus, one of the original parents of ridgwayi, is an exceptionally stable, virile form, adapting itself to the widely varying conditions of a breeding range that extends from the Rio Grande valley to the limit of trees. Note that in the accompanying table no adequately represented station is without evidences of the influence of aeneus. Hence it may be presumed that, by inheritance, ridgwayi is well equipped to hold its own, and possibly more.

It appears, therefore, that removed from contact with one parent and in a large measure from the other, the descendants of both have become the dominant type of grackle in a definite area where they promise fully to establish their independence as a well-marked, self-perpetuating form wholly deserving of recognition in zoological nomenclature.

This conclusion, with my earlier remarks on the origin of stonei, I submit in support of the belief that of the two post-glacial grackles constituting the stonei-ridgwayi complex, the former originated by mutation, the latter through the interbreeding of allied forms.

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TABLE 2

	IA	BLE 2					
	Florida Grackle No. 1	Intermediates	Stone's Grackle No. 2	Intermediates	Ridgway's Grackle No. 3	Intermediates	Bronzed Grackle No. 4
New Jersey Penns Grove Lakehurst West End (near Long Beach) Crosswicks, 12 mi. s. Princeton Princeton Raritan Morristown North Plainfield		1 1 2 2	3 3 4 1 1 3	2 1 3	1 1 2 1 2	2 1	
New York Staten Island (Butler Estate) Central Park, New York City West Farms Rye White Plains Ossining			4	4 2 1 4	1 3 3	1	1
Connecticut Westville (near New Haven) Simsbury (n. of Hartford) Litchfield					1 1 1 1	2 2	1
Long Island Floral Park Old Westbury Jericho Locust Valley Mill Neck Bayville Oyster Bay Cove Neck		1	1 1 1 1 1 4	2 1 1 4	3 7 1 3 7 9	1 1 1 5	1
Plainview Farmingdale Greenlawn Seaford Cold Spring Harbor Brentwood Bay Shore Central Islip Smithtown			1	1	3 7 1 1 1 1 1 8 8	3	
Sinicitown Lake Ronkonkoma Brookhaven Moriches Eastport Speonk Westhampton			2	2	1 1 1 3	1 2 1	

TABLE 2-Continued

	Florida Grackle No. 1	Intermediates	Stone's Grackle No. 2	Intermediates	Ridgway's Grackle No. 3	Intermediates	Bronzed Grackle No. 4
Long Island Hampton Bays Easthampton					1 5		
Amaganset Shelter Island Greenport Orient				1	5 1 24 2 2 8	10	
Orient Point Gardiner's Island			1	1	8	2	
Massachusetts Martha's Vineyard Nantucket					3	5 2	4 3

I append a list of those to whom I am indebted for the birds recorded in the preceding table, together with a statement of the localities represented. Specimens from the remaining localities were collected by Mr. Sven Raven, of the Museum staff. Dr. Stanley C. Ball, near New Haven; Dr. Thomas Barbour, Nantucket, Martha's Vineyard; Mrs. Gladys Gordon Fry, Oyster Bay; Mr. John Galm, Central Park; Mr. Winston Guest, Gardiner's Island; Dr. W. T. Helmuth, Easthampton; Mr. Roy Latham, Orient, Orient Point; Mr. Charles H. Rogers, Crosswicks, Princeton; Dr. Eugene Swope, Oyster Bay; Mr. Leroy Wilcox, Speonk; Mr. W. W. Worthington, Shelter Island.

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### BIRDS OF LAS VIGAS, VERACRUZ<sup>1</sup>

BY GEORGE MIKSCH SUTTON AND THOMAS D. BURLEIGH

Las Vigas is a quiet, not very colorful, middle-sized village in western Veracruz. It is situated at the northeastern base of the Cofre de Perote, at an elevation of 8000 feet. It may be reached by railroad or by highway from Jalapa (from the east) or Puebla (from the west). About it lie open, sloping fields. The original pine forest has been cut off or thinned out for miles around. Las Vigas is well known in ornithological circles. It is the type locality for several forms, including a remarkable 'Screech' Owl, Otus pinosus, which is known only from the type specimen. De Oca, Ferrari-Perez, Nelson, Goldman, Chapman, Isham and Trujillo have worked there. The most convenient report on the birds is Chapman's annotated list of forty-eight species (Bull. Amer. Mus. Nat. Hist., 10: 15-43, Feb. 24, 1898), based on a ten-day spring sojourn (April 17 to 27) in 1897.

In early April of 1939 John B. Semple, Frederick W. Loetscher, and the authors visited Las Vigas for a few days, recording a total of 89 bird forms. It is thought that a comparison of the 1939 and 1897 lists will be of value not alone because the two lists represent somewhat different seasons of the year but because with the passing of almost half a century there have been significant ecological changes.

## POINTS VISITED IN 1939

The country most thoroughly investigated in 1939 was that from two to six miles south and southeast of the village; the borders of the highway and open fields near town; and the rock-strewn, mixed woodlands between Las Vigas and La Joya, a village four or five miles east of Las Vigas (on the road to Jalapa) at about 7000 feet elevation.

The party of four visited Las Vigas from April 1 to 4, inclusive. Loetscher remained thereafter until April 10. April 1 the thinned-out woods near town were cursorily inspected. April 2, the thicker timber to the south (8500 to 9000 feet) was investigated. April 3, the whole district between Las Vigas and La Joya was traversed. April 4, the mountain south of Las Vigas was climbed, where fine tree-growth was reached at elevations of from 8500 to 10,000 feet. The section visited by Loetscher between April 5 and 10 was that lying to the east of Las Vigas in the general direction of La Joya.

<sup>&</sup>lt;sup>1</sup> First of a series of papers on the 1939 John B. Semple Expedition to eastern Mexico.

The woods about Las Vigas were almost wholly pine. Thin shrubbery grew in the clearings and along the steep slopes, but where the forest was dense there was no undergrowth. Below Las Vigas the woods were partly deciduous. Here, especially in sections where the trees were thin, there were tangles of vines and bushes. A notable feature of the terrain between Las Vigas and La Joya was the rough, scoriaceous rock. Where this rock covered the ground walking was difficult and dangerous. A pretty stream flowed down the mountainside into and through Las Vigas. Along this stream the trees had not been felled. Its sheltered banks were therefore good birding grounds, but they failed to yield a specimen of *Otus pinosus*.

Even in the remotest sections visited on April 4 there was evidence of lumbering. On a broad shelf south of the village the trees had long since been cut. Here a knee-high tangle of stiff shrubbery grew, giving the open flat somewhat the appearance of a huckleberry bog in the interior of Newfoundland.

### COMPARISON OF LISTS

A study and comparison of the 1897 and 1939 lists reveal the following facts:

- 1. Forty-six bird species were recorded both by Chapman in 1897 and by the authors and their companions in 1939. The two forms listed in 1897 but not in 1939 were transients, Hylocichla ustulata swainsoni and Seiurus noveboracensis.
- 2. Of the 48 species recorded in 1897, 28 were known or thought to be breeding. Two of these were considered 'abundant'—Junco phaeonotus and Peucedramus olivaceus; eight 'common'—Turdus migratoriũs, Parus sclateri, Vireo huttoni, Spinus pinus, Myiochanes pertinax, Plagiospiza superciliosa, Empidonax fulvifrons, and Loxia curvirostra; and six 'not uncommon' or 'tolerably common'—Psaltriparus melanotis, Sitta carolinensis, Sitta pygmaea, Vireo solitarius, Pipilo fuscus, and Antrostomus vociferus. All the above-named species were found to be common in 1939 save Pipilo fuscus, which was recorded only infrequently, and Antrostomus vociferus, which, judged by the number of birds actually seen or heard, was decidedly uncommon.
- 3. Of the 28 nesting species listed in 1897, twelve were considered 'not common' or were noted so infrequently as to indicate their being rare. These were: Sialia mexicana, Certhia familiaris, Ergaticus ruber, Hedymeles melanocephalus, Pipilo torquatus, Hesperiphona

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vespertina, Aphelocoma sordida, Empidonax affinis,<sup>2</sup> Dryobates villosus, Dryobates stricklandi, Colaptes cafer, and Corvus corax. Two of these, Colaptes cafer and Sialia mexicana, apparently have become more numerous during the past forty years. Aphelocoma sordida was thought to be local, rather than uncommon, in 1939. Hesperiphona vespertina was seen repeatedly in 1939, but it is known to be erratic in other parts of its range and may therefore be rare or absent during some years. At least one of the twelve above-named forms, Dryobates stricklandi, obviously has become rarer, presumably because of the removal of the pine woods. The other seven are holding their own.

4. One species, *Piranga flava*, recorded as a transient or winter visitant in 1897, is thought to be represented today by a more or less extensive breeding population. Certainly it is fairly common in the pine woods near Las Vigas. It may be represented by two or more races during the course of the year.

5. Two species recorded in 1897 presumably represented a breeding population, but no definite nesting data were obtained: Troglodytes brunneicollis and Myioborus miniatus. These must remain in the same category. The former apparently is commoner today than it was forty years ago.

6. Of the 43 forms recorded in 1939 but not in 1897, the following sixteen probably are transients that are present only for brief periods during the year or as winter visitants: Accipiter cooperii, Accipiter striatus, Buteo swainsoni, Buteo platypterus, Falco columbarius, Charadrius vociferus, Antrostomus v. vociferus, Archilochus alexandri, Sayornis saya, Empidonax hammondii, Mniotilta varia, Dendroica townsendi, Dendroica occidentalis, Dendroica graciae, Dendroica coronata, and Icterus bullocki; and the following ten are nesting species that are thought to prefer mixed woodlands to the pine woods about Las Vigas proper: Eugenes fulgens, Hylocharis leucotis, Trogonurus mexicanus, Trogonurus ambiguus, Pyrocephalus rubinus, Henicorhina leucophrys, Ptilogonys cinereus, Basileuterus belli, Tanagra elegantissima, and Atlapetes pileatus. It is not surprising that many of the above-named 27 forms were not included in the 1897 list, for that list was predominantly one of the nesting birds of the pine forest, and Chapman did not, presumably, visit the mixed woodland about La Joya.

Seventeen forms remain to be accounted for. Three of these, Otus

<sup>&</sup>lt;sup>2</sup> Empidonax fulvipectus of Ridgway, Hellmayr, et al. For use of affinis see van Rossem, Bull. Mus. Comp. Zool., 77: 392-393, 1934.

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flammeolus, Nephoecetes niger, and Streptoprocne zonaris, often escape detection even in regions where they are common. Five are birds that have no particular aversion to heavy pine woods and were probably present in 1897, though they may have been rare: Buteo jamaicensis, Empidonax difficilis, Cyanocitta stelleri, Vermivora superciliosa, and Catharus occidentalis. Three obviously are uncommon today, though individuals recorded in 1939 are thought to represent a breeding population—Geothlypis nelsoni, Spinus psaltria, and Sialia sialis; and six are well known, widely distributed forms that probably have extended their winter or breeding range as a result of highway building or clearing away of the forest: Falco sparverius, Zenaidura macroura, Lanius ludovicianus, Tachycineta thalassina, Carpodacus mexicanus, and Polioptila caerulea.

### SPECIES RECORDED IN 1939

BLACK VULTURE, Coragyps atratus.—Not common. Noted by Chapman in 1897 as one of the three species occurring both at Las Vigas and at Jalapa.

TURKEY VULTURE, Cathartes aura.—Noted occasionally along the highway. Chapman observed "a few . . . daily" in 1897.

COOPER'S HAWK, Accipiter cooperii.—Noted once, a single bird, a mile east of Las Vigas, April 8 (Loetscher).

Sharp-shinned Hawk, Accipiter striatus.—Observed once, near La Joya, April 2 (Burleigh).

RED-TAILED HAWK, Buteo jamaicensis.—Mated pair seen at 9500 feet, south of Las Vigas, April 4 (Loetscher).

Swainson's Hawk, Buteo swainsoni.—Flock of several hundred seen on morning of April 5 between Jalapa and Las Vigas (Semple and Burleigh). Noted later in the day by Loetscher, who observed many individuals at close range, most of them in the light phase of plumage, others black. Circling low over the mountains, the whole flock moved gradually northward.

BROAD-WINGED HAWK, Buteo platypterus.—Two noted in flock of Swainson's Hawks that passed over April 5 (Loetscher).

PIGEON HAWK, Falco columbarius.—An adult seen chasing a small bird, a mile east of Las Vigas, April 8 (Loetscher).

Sparrow Hawk, Falco sparverius.—One seen near highway five miles west of Las Vigas, April 1 and 5. Presumably this species has become commoner as a result of deforestation.

KILLDEER, Charadrius vociferus.—One seen and heard flying over Las Vigas, April 1 (Loetscher).

WESTERN MOURNING Dove, Zenaidura macroura marginella.—Mourning Doves were noted infrequently along the highway in the open country west of Las Vigas. An adult female (ovary much enlarged) taken near La Joya, April 4 (Semple), is of this race, the wing measuring 140 mm., the tail 120. Chapman did not record the Mourning Dove in 1897. Like the Sparrow Hawk it probably is becoming commoner as a result of opening-up of the country.

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FLAMMULATED SCREECH OWL, Otus flammeolus flammeolus.—Recorded but once: an incubating female taken at the nest, at about 10,000 feet, April 4 (Sutton). The nest cavity, which held three heavily incubated eggs, apparently was an old flicker's. It was about fifteen feet from the ground in a dead stub. The owl's eyes were dark brown.

EASTERN WHIP-POOR-WILL, Antrostomus vociferus vociferus.—A female whip-poor-will taken near La Joya, April 3 (Semple) proves to be the well-known bird of the eastern United States. It was the only one of this subspecies seen.

MEXICAN WHIP-POOR-WILL, Antrostomus vociferus setosus.—The few whip-poor-wills heard near Las Vigas on the evening of April 4 and early the following morning presumably were of this subspecies. A breeding male, taken after dark with a flashlight along a wooded gully, was calling energetically and feeding among the tops of the highest trees, possibly seventy-five feet from the ground (Sutton). The type of Wagler's Caprimulgus macromystax has proved to be a specimen of the common Whip-poor-will of the eastern United States, so the name setosus has been proposed (see van Rossem, Bull. Mus. Comp. Zool., 77: 408, 1934).

BLACK SWIFT, Nephoecetes niger.—Noted repeatedly about an open flat at 10,000 feet, south of Las Vigas, April 4 (Sutton and Loetscher).

MEXICAN COLLARED SWIFT, Streptoprocne zonaris mexicana.—Noted only on April 4, when Semple took a male and a female a mile east of Las Vigas, and Loetscher and Sutton saw a few birds circling above a flat at 10,000 feet, a few miles south of the village.

BLACK-CHINNED HUMMINGBIRD, Archilochus alexandri.—Female taken at Las Vigas, April 2 (Sutton). Ovary not enlarged; no male seen.

RIVOLI'S HUMMINGBIRD, Eugenes fulgens fulgens.—Subadult male taken between Las Vigas and La Joya, April 3 (Burleigh). Two adult males noted at same place the same day. Not seen in pine woods above Las Vigas.

WHITE-EARED HUMMINGBIRD, Hylocharis leucotis leucotis.—Noted several times near Las Vigas, April 3; two males were collected on that date at 7600 feet, between Las Vigas and La Joya (Sutton).

MEXICAN TROGON, Trogonurus mexicanus mexicanus.—Male seen near La Joya, April 3 (Sutton). Male taken near La Joya, April 9 (Loetscher). No trogon of any sort was seen by Chapman in 1897.

COPPERY-TAILED TROGON, Trogonurus ambiguus.—Male seen at close range (tail closely observed) in low woods not far from La Joya, April 9 (Loetscher). A male trogon seen April 4, in pine woods above Las Vigas (10,000 feet) probably was of this species.

MEXICAN RED-SHAFTED FLICKER, Colaptes cafer mexicanus.—Red-shafted Flickers were fairly common in the pine woods about Las Vigas. Some of these may have been transients or winter visitants. Incubating male of present race (wing, 151 mm.) taken April 2 (Sutton).

STRICKLAND'S WOODPECKER, Dryobates stricklandi.—Rare. Female taken near Las Vigas, April 4 (Loetscher). One of the species that has apparently become rarer with the cutting of the big trees.

JARDINE'S HAIRY WOODPECKER, Dryobates villosus jardinii.—Fairly common. Female specimens (with distinct brood patch) taken April 1–3 (Sutton and Loetscher). Appears to be holding its own in spite of extensive lumbering.

SAY'S PHOEBE, Sayornis saya saya.—Noted but once: a male (gonads somewhat enlarged) taken four miles east of Las Vigas, April 3 (Loetscher).

FULVOUS-BREASTED FLYCATCHER, Empidonax affinis affinis.—Fairly common in pine woods about Las Vigas; male and female specimens were taken April 2-4. Chapman took four specimens in 1897.

SALVIN'S WESTERN FLYCATCHER, Empidonax difficilis salvini.—Presumably this bird nests in the region, though the only specimen taken (male, April 2, Sutton) was not in breeding condition. This is the Empidonax difficilis bairdi of Ridgway (for change of name see van Rossem, Bull. Mus. Comp. Zool., 77: 393-394, 1934).

HAMMOND'S FLYCATCHER, Empidonax hammondii.—One recorded: a female, taken near Las Vigas, April 10 (Loetscher).

RUDDY BUFF-BREASTED FLYCATCHER, Empidonax fulvifrons rubicundus.—Fairly common at from 8000 to 9000 feet. Specimens taken April 2-4 (Burleigh and Loetscher). Chapman recorded this species repeatedly in 1897, discovering a 'nearly completed' nest April 26.

SWAINSON'S FLYCATCHER, Myiochanes pertinax pertinax.—Common in the pine woods. Breeding specimens taken April 1-3. Considered "common" by Chapman in 1897.

OLIVE-SIDED FLYCATCHER, Nuttallornis borealis.—Noted but once: a male, taken April 4, four miles south of Las Vigas, at about 9800 feet (Sutton). Four individuals were noted by Chapman in 1897.

VERMILION FLYCATCHER, Pyrocephalus rubinus.—Noted once, a single male, just east of Las Vigas, April 8 (Loetscher).

VIOLET-GREEN SWALLOW, Tachycineta thalassina.—Violet-green Swallows, presumably of the subspecies mexicanus, for they appeared to be established for the season, were noted repeatedly about Las Vigas, April 1—9.

BLUE-CRESTED JAY, Cyanocitta stelleri coronata.—This handsome bird (which was not observed by Chapman in 1897) was seen several times near Las Vigas and La Joya; specimens were taken April 2-4 (Semple and Burleigh). These are alike in being strikingly blue on the crest. This is surprising in view of the fact that the type locality for the black-crested subspecies, C. s. azteca Ridgway, is 'Mirador,' which is said to be less than fifty miles away, midway between Huatusco and Jalapa, at 4100 feet. Blue-crested Jays were seen on the mountain south of Las Vigas also on April 4, at from 9000 to 10,000 feet (Sutton and Loetscher).

SIEBER'S JAY, Aphelocoma sordida sieberii.—Small flock seen, April 4, at 10,000 feet (Sutton). Female (with basal half of lower mandible flesh-colored as in A. s. arizonae) taken from fair-sized flock at Las Vigas, April 5 (Loetscher). Noted by Chapman in 1897.

American Raven, Corvus corax sinuatus.—Not common. Two seen circling above Las Vigas, April 3. Chapman observed "two or three . . . daily" in 1897.

MEXICAN CHICKADEE, Parus sclateri sclateri.—Noted several times. Breeding female taken at 9000 feet, April 2 (Burleigh). Recorded by Chapman in 1897 as "not common."

BLACK-EARED BUSHTIT, Psaltriparus melanotis melanotis.—Noted several times. Breeding male taken at 8000 feet, April 4 (Burleigh). Noted by Chapman in 1897 as "not common."

MEXICAN WHITE-BREASTED NUTHATCH, Sitta carolinensis mexicana.—Noted in the pine woods about Las Vigas, but not #t La Joya. Breeding male taken at former place, April 1 (Burleigh). Noted by Chapman in 1897 as "tolerably common." Like Dryobates villosus jardinii, apparently holding its own.

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CHIHUAHUAN PIGMY NUTHATCH, Sitta pygmaea chihuahuae.—Fairly common in the pine woods. Breeding male (wing 71 mm., tail 38) collected and occupied nest found, April 4 (Sutton). Considered "tolerably common" in 1897 by Chapman.

MEXICAN BROWN CREEPER, Certhia familiaris alticola.—Fairly common in pine woods at from 8000 to 10,000 feet. Breeding male collected near Las Vigas, April 2 (Burleigh). Nest with two fresh eggs found April 4 (Sutton and Loetscher). Nest seven feet from ground, under slab of bark. The species was noted several times by Chapman in 1897, who took four specimens that year.

Brown-throated Wren, Troglodytes brunneicollis brunneicollis.—Specimens with unenlarged gonads collected April 1-3. Considered "rather uncommon" by Chapman in 1897. May be increasing as a result of clearing away of heavy pine woods.

House Wren, Troglodytes domesticus.—Seen once, April 3, at 9000 feet (Sutton and Loetscher). Chapman took two 'Troglodytes aëdon' specimens in 1897.

MEXICAN WOOD WREN, Henicorhina leucophrys mexicana.—This attractive species which Chapman did not record in 1897, was noted by us once only in the immediate vicinity of Las Vigas; but at slightly lower elevations to the east it was common. Specimens taken there April 3.

Veracruz Robin, Turdus migratorius phillipsi.—Common and nesting. Male taken near La Joya, April 3 (Burleigh). Considered "common" by Chapman in 1897. Probably increasing steadily with the clearing away of the forest.

FULVOUS NIGHTINGALE-THRUSH, Catharus occidentalis fulvescens.—Fairly common in pine and mixed woodlands at from 7000 to 9000 feet. Specimens taken April 1-4 (compared directly with type). Testes of male taken April 4 measured 6 x 5 mm., and birds were seen chasing each other as if in courtship, but no other signs of breeding observed. Chapman did not record any member of the genus Catharus at Las Vigas in 1897, though he listed both C. mexicanus and C. melpomene from Jalapa. Shrubbery in the clearings at Las Vigas may conceivably be responsible for the presence of occidentalis there at the present time.

AUDUBON'S HERMIT THRUSH, Hylocichla guttata auduboni.—Hermit Thrushes were noted several times at from 7000 to 10,000 feet. A female collected April 4 (Loetscher) is of the present subspecies (wing 103 mm., tail 76). Chapman took two specimens of auduboni in 1897.

GUATEMALAN BLUEBIRD, Sialia sialis guatemalae.—Male (wing 105.5 mm., tail 70) with enlarged testes taken two miles east of Las Vigas, April 8 (Loetscher). Chapman did not note S. sialis in 1897.

Nelson's Bluebird, Sialia mexicana australis.—Fairly common. Several nesting pairs noted and two males collected at from 8000 to 8600 feet, April 2-4. Chapman considered this bird "not common" in 1897. It probably has increased with thinning of the forest.

Blue-gray Gnatcatcher, Polioptila caerulea.—Seen once near Las Vigas at close range, April 2 (Loetscher and Sutton).

RUBY-CROWNED KINGLET, Corthylio calendula.—Noted several times at from 7000 to 10,000 feet, April 1–4. Abundant April 8, when a migratory wave must have passed through (Loetscher). Considered "not common" by Chapman in 1897.

Anthus sp.—A single pipit was seen and heard as it flew over Las Vigas, April 4 (Loetscher).

MEXICAN PTILOGONYS, Ptilogonys cinereus.—Four seen above Las Vigas, at 9000 feet, April 2 (Loetscher). Not recorded by Chapman in 1897.

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Lanius ludovicianus.—A shrike was seen along the highway just west of Las Vigas on the morning of April 5. This species (which was not seen by Chapman in 1897) probably has made its way into the Las Vigas section during recent years.

Mexican Hutton's Vireo, Vireo huttoni mexicanus.—Fairly common. Breeding specimens collected at 7500 feet, April 3. Considered "common" by Chapman in 1897.

PLUMBEOUS VIREO, Vireo solitarius plumbeus.—Fairly common at from 8000 to 10,000 feet. Breeding males taken April 4-7 (Burleigh and Loetscher). One of these (wing 85 mm., tail 62) is large enough to suggest that the breeding form is V. s. pinicolus van Rossem, but the other (wing 80, tail 56) is so much shorter-winged and -tailed that we are obliged to call Las Vigas birds plumbeus, the same race as that breeding in the Chisos Mountains, in Brewster County, Texas.

BLACK AND WHITE WARBLER, Mniotilta varia.—One seen between Las Vigas and La Joya, at 7500 feet, April 3 (Loetscher). Not noted by Chapman in 1897.

NASHVILLE WARBLER, Vermivora ruficapilla.—Noted four times by Loetscher: twice April 1; once April 2; and once April 9. Taken by Chapman in 1897.

MEXICAN HARTLAUB'S WARBLER, Vermivora superciliosa mexicana.—Noted several times. Breeding male collected along stream just south of Las Vigas, April 2 (Sutton). Chapman did not record this species in 1897.

OLIVE WARBLER, Peucedramus olivaceus olivaceus.—Common; mated pairs and singing males were noted daily in larger pines. Male (with enlarged testes) taken April 2 (Loetscher). Considered "abundant" by Chapman in 1897.

MYRTLE WARBLER, Dendroica coronata.—Noted with certainty but twice: an adult female collected April 1 (Loetscher), and a female in immature plumage collected April 4 (Sutton). Not seen by Chapman in 1897.

AUDUBON'S WARBLER, Dendroica auduboni.—Noted several times, but no specimen taken. Chapman noted it but once in 1897, collecting a female in full plumage April 23.

TOWNSEND'S WARBLER, Dendroica townsendi.—Noted several times April 4, at from 9000 to 10,000 feet, south of Las Vigas; a male was taken that day (Loetscher). Male seen by Chapman in 1897.

BLACK-THROATED GREEN WARBLER, Dendroica virens.—Noted once: an adult male, at 7500 feet, April 3 (Sutton). Male D. v. virens, collected by Chapman April 24, 1897. (Identification by Frederick W. Loetscher.)

HERMIT WARBLER, Dendroica occidentalis.—Noted repeatedly at from 7000 to 10,000 feet. Male and female specimens taken April 2-4 (Sutton). Not recorded by Chapman in 1897.

GRACE'S WARBLER, Dendroica graciae graciae.—Noted but once: a male in full breeding plumage, taken at 8200 feet, April 2 (Sutton). Not noted by Chapman in 1807.

MACGILLIVRAY'S WARBLER, Oporornis tolmiei.—Noted three times, 8000 to 9000 feet, April 4. Chapman collected two males in 1897.

HOODED YELLOWTHROAT, Geothlypis nelsoni nelsoni.—Yellowthroats were recorded several times in brush-grown, slightly marshy spots. Adult male (wing 53 mm., tail 57) of present form collected at 8000 feet, April 4, along stream that flowed through Las Vigas (Burleigh). Transient G. trichas not seen. No Yellowthroat was recorded by Chapman in 1897.

Bell's Warbler, Basileuterus belli.—One noted three miles east of Las Vigas, April 9 (Loetscher).

RED WARBLER, Ergaticus ruber.—Fairly common at from 7500 to 9000 feet. Breeding males taken near Las Vigas, April 2. Near La Joya a bird was seen carrying thin grasses to its unfinished nest, April 3 (Sutton). Noted by Chapman in 1897, who took a nesting pair April 24.

WILSON'S WARBLER, Wilsonia pusilla.—Noted daily. Most numerous April 8 (Loetscher). Noted by Chapman in 1897, who collected a male specimen of the western race, W. p. pileolata, April 24. (Identification checked by John T. Zimmer.)

RED-BELLIED REDSTART, Myioborus miniatus miniatus.—Not common. Male collected near Las Vigas at 9000 feet, April 2 (Burleigh). Noted but once by Chapman in 1897: a male collected April 25.

BULLOCK'S ORIOLE, Icterus bullocki.—Noted but once: an adult male taken April 2, at 8200 feet (Sutton).

Brewer's Blackbird, Euphagus cyanocephalus.—Noted but once, a small flock a mile west of Las Vigas on the morning of April 5. "Several flocks" observed by Chapman in 1897.

EASTERN HEPATIC TANAGER, Piranga flava dextra.—P. flava was noted repeatedly in the pine woods near Las Vigas. The only specimens taken, a male (wing 97 mm., tail 80) in not quite full breeding dress (April 3, Sutton) and two females (wing 98, 99; tail 80, 81) in breeding condition (April 1 and 7, Loetscher), are like topotypical dextra in color, but the females are a trifle long-tailed for that race according to Zimmer ('A study of the Tooth-billed Red Tanager, Piranga flava,' Field Mus. Nat. Hist., Zool. Ser., 17: 211, Dec. 18, 1929), who states that the tail-length of female dextra is "77–79.5 (av. 78.1)."

Chapman listed 'Piranga hepatica' in 1897, commenting only on a female specimen with "slightly enlarged" ovary taken April 23 (1898, 40).

BLUE-HOODED EUPHONIA, Tanagra elegantissima.—Seen only in the vicinity of La Joya, where a male and a female were taken at 7200 feet, April 3 (Burleigh). Not seen in the immediate vicinity of Las Vigas.

BLACK-HEADED GROSBEAK, Hedymeles melanocephalus melanocephalus.—Noted three times. Female (wing 98 mm., tail 80) with slightly enlarged ovary collected four miles east of Las Vigas, April 3 (Loetscher). Recorded by Chapman in 1897: a singing male with "much enlarged testes" taken April 24.

MEXICAN EVENING GROSBEAK, Hesperiphona vespertina montana.—Fairly common at from 8000 to 10,000 feet. Breeding birds taken April 1-2 (Sutton). Among the specimens collected by Chapman in 1897 was a "young male but a few days from the nest."

HOUSE FINCH, Carpodacus mexicanus.—Seen several times, but no specimen collected. Not recorded by Chapman in 1897.

MEXICAN PINE SISKIN, Spinus pinus macropterus.—Common and noisy in pine woods at from 8000 to 10,000 feet. Specimens in breeding condition taken April 1-4 (Burleigh). These measure—male: wing, 75; tail, 49; female: wing, 70; tail, 48. A perfect siskin skeleton (with some feathers attached) found at 10,000 feet, April 4 (Sutton). Chapman considered this species 'common' in 1897.

ARKANSAS GOLDFINCH, Spinus psaltria psaltria.—Noted but once: a male with enlarged testes taken at Las Vigas, April 7 (Loetscher). Not seen by Chapman in 1897.

MEXICAN CROSSBILL, Loxia curvirostra stricklandi.—Small flocks noted from time to time in high pines. Breeding males collected April 1 (Burleigh and Loetscher). Considered 'common' by Chapman in 1897.

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COLLARED TOWHEE, Pipilo torquatus torquatus.—Rare, the only one recorded being a male (with greatly enlarged testes) collected on a steep slope among bushes at the edge of a clearing at 8500 feet, a mile or so south of Las Vigas (Sutton). Chapman took a breeding male in 1897.

PLATEAU BROWN TOWHEE, Pipilo fuscus potosinus.—Rare: our only specimen was a breeding male taken in the immediate vicinity of Las Vigas, April 4 (Burleigh). It was compared directly with Ridgway's type in the U. S. National Museum. Chapman considered this bird 'not uncommon' in 1897. Its rarity at the present time is puzzling.

STRIPED SPARROW, Plagiospiza superciliosa.—Decidedly local, but not rare. Noted in brush-lined gully south of Las Vigas and along highway between Las Vigas and La Joya. Females (with ovary greatly enlarged) taken April 2-4 (Semple and authors). Many noted and male collected April 8 (Loetscher). Chapman considered this species 'common' in 1897.

MEXICAN JUNCO, Junco phaeonotus phaeonotus.—Abundant, especially in open woodlands, at from 7000 to 10,000 feet. Breeding specimens taken. Chapman considered this bird 'abundant' in 1897.

Western Chipping Sparrow, Spizella passerina arizonae.—Small flocks of Chipping Sparrows were noted several times near La Joya (along the highway) as well as at Las Vigas, but no full songs were heard so presumably no nesting territories were being advertised or defended. Female (ovary somewhat enlarged) of the present subspecies collected two miles east of Las Vigas, at 7600 feet, April 8 (Loetscher). Identification was checked by Dr. Alexander Wetmore, of the Smithsonian Institution. Specimens taken by Chapman in 1897 from "flocks in the cleared fields" also have been identified as arizonae.

EASTERN LINCOLN'S SPARROW, Melospiza lincolnii lincolnii.—Lincoln's Sparrows were noted from time to time in brushy places, a female of the present race being taken at 8000 feet, April a (Loetscher).

RUFOUS-CAPPED SPARROW, Atlapetes pileatus.—Noted twice on bushy hillsides: a single bird, April 3, four miles east of Las Vigas; and a single bird, April 8, just below Las Vigas (Loetscher).

The authors wish to thank Mr. Loetscher for his careful reading of the manuscript; Mr. William Montagna, the senior author's assistant, for measuring certain specimens; Dr. Alexander Wetmore and Mr. John T. Zimmer for identifying certain specimens; and the authorities of the U. S. National Museum, U. S. Biological Survey, American Museum of Natural History, and Museum of Comparative Zoology for their assistance in various ways.

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#### GENERAL NOTES

Audubon's Shearwater on New Jersey coast.—On August 19, 1939, there was a southeasterly storm along the New Jersey coast. On the following day (August 20) while walking along the beach at Mantoloking in Ocean County, the writer found the remains of an Audubon's Shearwater (Puffinus lherminieri) which had been washed up by the high tide during the storm. There was a hole in the breast as though a gull had started to eat it, and one side of the head was damaged. It nevertheless proved fresh enough to skin, and the indications are that it died during the storm. There was no trace of oil on the feathers and no fat was encountered in the skinning. The specimen, a male, has been identified by Dr. Robert Cushman Murphy of the American Museum of Natural History, as typical Puffinus l. lherminieri. It has been deposited in the Princeton Museum of Zoölogy, and appears to be the second record for this species in New Jersey. The only other record is that of one found at Cape May on August 2, 1926, by the late Witmer Stone (Auk, 43: 536, 1926).

The writer thinks it worth noting that many seabirds washed up on the beach in what may appear to be a very poor condition, can be made into relatively presentable skins.—ROBERT WINTHROP STORER, South Orange, New Jersey.

Black-capped Petrel in New York.—Mr. Lee J. Loomis, of Endicott, New York, recently brought to my attention an unreported specimen of Black-capped Petrel, Pterodroma hasitata, from New York State. The bird, a male, was captured alive by two schoolboys near Hiawatha Island (in the Susquehanna River), not far from Endicott, Broome County, on August 26, 1933. It was so nearly dead that it made no attempt to swim or fly. Presumably it had been driven inland by the hurricane that struck the Binghamton region on August 24.

Cornell University has obtained the specimen through an exchange with Mr. Loomis. It is in excellent plumage though the three outermost primaries and two or three inner secondaries on each wing are more or less sheathed at the base, and some of the rectrices are missing. According to Eaton (Birds of New York, p. 160, 1910) the Black-capped Petrel has been recorded in New York State four times previously.—George Mirsch Sutton, Curator of Birds, Cornell University, Ithaca, New York.

Barrow's Golden-eye in Connecticut.—Two diving ducks were sighted on the Connecticut River in South Windsor, Connecticut, on the morning of November 19, 1939. Upon closer observation one bird was immediately identified as a drake Barrow's Golden-eye (Glaucionetta islandica). The birds were seen in good light, perhaps 150 yards north of the observation point, through a three-inch telescope by four observers, Messrs. Eugene Schmidt, Dan McDavid, G. O'Brien, and the writer. They were first seen on the water diving, and remained under the glass for about five minutes until frightened by an approaching boat, when they flew northward, low over the water. The very large patch of white coming almost to the top of the bill, and the distinctive intermingling of the black and white on the sides were clearly seen. The second bird was certainly a female Golden-eye, but apart from the fact that it was the only other bird in the vicinity, nothing enabling us to distinguish it as a Barrow's was seen, though the probability is obviously strong that this was a pair.

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There are no recent records for this State. Sage and Bishop ('Birds of Connecticut,' 1913) report birds killed November 14, 1867, in the Sound; December 25, 1883, East Haven. Bagg and Eliot ('Birds of the Connecticut Valley in Massachusetts', 1937) give four records for the Massachusetts valley region, the latest being of two in November, 1935. Forbush ('Birds of Massachusetts') has one for Vermont in 1917. Brown, Edwards, and Wolfarth report a drake on Sandy Hook Bay, February, 1939 (Auk, 56: 329-330, 1939).

It may be more than a coincidence that of the eight records cited for the Valley region, including this one, five fall in November, three of them in the third week.—
M. L. HOFFMAN, Hartford, Connecticut.

Water bulrush as a food of waterfowl.—In connection with the waterfowl studies of the Maine Cooperative Wildlife Research Unit, a series of duck stomachs was collected during the fall of 1938 and analyzed by the writers. In compiling the results of stomach analyses, one of the outstanding features was the prevalence of root bulbs (tuber-like enlargements of the rhizomes) and fibrous materials of the water bulrush (Scirpus subterminalis), which had been eaten by birds taken on the Penobscot River and immediate vicinity. Since this plant apparently has been little recognized as of value to waterfowl, a separate tabulation was made of the food of all birds taken on Folsom Pond, Lincoln, Maine, and on the Penobscot River between the villages of Lincoln and Howland. Twenty-five ducks of eight species were collected from these waters during the months of October and November. Stomach analyses were based upon dry material and were determined according to the percentage-by-bulk method as practiced by the U. S. Biological Survey. Assistance in identification of food materials was given by staff members of the Botany and Zoology Departments at the University of Maine.

Twelve stomachs of the Ring-necked Duck (Nyroca collaris) were secured from the area mentioned. One stomach was practically devoid of food but the remaining eleven contained materials expressed in percentages as follows: root bulbs and fibers of water bulrush (Scirpus subterminalis), 83.09; snails (Gastropoda), 11.36; seeds of bur reed (mainly Sparganium fluctuans), 2.73; seeds of water shield (Brasenia Schreberi), 1.55; seeds of pondweed (mainly Potamogeton pusillus or P. gramineus, together with smaller amounts of both P. obtusifolius and P. epihydrus), 1.0; seeds of cherry (Prunus sp.), 0.27.

The stomachs of five Black Ducks (both Anas rubripes rubripes and A. r. tristis) contained food materials expressed in percentages as follows: root bulbs and fibers of water bulrush (Scirpus subterminalis), 54.0; snails (Gastropoda), 24.8; seeds of bushy pondweed (Naias flexilis), 13.6; bur reed (Sparganium chlorocarpum), 3.2; pondweed (Potamogeton natans), 1.4; water shield (Brasenia Schreberi), 1.4; miscellaneous, 1.6.

Two Wood Ducks (Aix sponsa) were secured and, although one of these birds had not eaten any Scirpus subterminalis, the other had fed upon practically nothing else. The complete food analyses of these two specimens showed the following percentages: water bulrush (Scirpus subterminalis), 49.5; arrowhead (Sagittaria latifolia), 14.5; insects and miscellaneous animal food, 10.0; snails (Gastropoda), 7.0; seeds of cherry (Prunus sp.), 5.0; water shield (Brasenia Schreberi), 2.5; pondweed (Potamogeton epihydrus), 2.5; miscellaneous and unidentified plant material, 9.0.

One Golden-eye (Glaucionetta clangula americana) had made a complete meal of Scirpus subterminalis. A Bufflehead (Charitonetta albeola) had eaten portions of this bulrush to the extent of 66% of the total stomach contents, the re-

mainder of its food being snails (Gastropoda). The stomach contents of a Greater Scaup (Nyroca marila) consisted of Scirpus subterminalis, 96%, and snails (Gastropoda), 4%, while a stomach of a Lesser Scaup (Nyroca affinis) showed traces of Scirpus subterminalis although the predominating food consisted of snails (Gastropoda), 100%. Two Hooded Mergansers (Lophodytes cucullatus) had fed entirely on larvae of dragonflies, and constituted the only waterfowl species collected which showed no traces of Scirpus subterminalis in the stomachs.

Even including the two Hooded Mergansers, the tabulated contents of 24 water-fowl stomachs showed that Scirpus subterminalis made up more than 64% of the total food eaten by these birds. Of the 25 ducks collected, 21 had eaten varying amounts of the plant. As far as the writers are aware, quantitative published data are lacking in which this plant is mentioned as waterfowl food. The files of the Food Habits Section of the Biological Survey, according to a letter from Dr. Clarence Cottam, contain neither field observations nor stomach records pertaining to the subject. In McAtee's recent book ('Wildfowl Food Plants', 1939), Scirpus subterminalis is merely listed without specific reference, although the bulbous bases of a marsh form, Scirpus pauciflorus, are said to constitute an important wildfowl food at James Bay, Canada.

In the stomachs taken in Maine and here reported on, fragments of leaves, roots and stems of this plant were occasionally found during the analyses, but the root bulbs were the food items ordinarily present. In connection with this, some interesting field observations were obtained on the Penobscot River near Howland, Maine, about the first of November, 1938. At this time the fall migration was at its height and large flocks of Ring-necked Ducks, Golden-eyes, Scaups, Black Ducks, Buffleheads and Wood Ducks were present on the river. The principal foods available in this section at the time were Sparganium (S. fluctuans and S. chlorocarpum), Sagittaria latifolia, Pontederia cordata, Carex sp., and Potamogeton (primarily P. natans and P. amplifolius). Wild rice (Zizania aquatica var. angustifolia) is very abundant in this portion of the river but most of the panicles had already been stripped of grain by the resident ducks and earlier migrants. On the date in question, the flocks were confining their feeding to those areas where Scirpus subterminalis was most abundant, and the heads of the islands and the snags below the feeding area were covered with drifted fragments of the plant. The Black Ducks and Wood Ducks appeared to be obtaining bulbs and fragments that had been dislodged by the bottom-feeding activities of the diving ducks. The birds seemed reluctant to leave the vicinity, even after a few had been collected, and many of them returned shortly after the observers had stopped shooting. Specimens of the plant were secured at the time of the observations and these, as well as the bulbs later found in the stomachs, were identified by Dr. F. H. Steinmetz of the Botany Department of the University of Maine. This aquatic bulrush was found growing in abundance, although in scattered patches, on the Penobscot River in water four to six feet deep, and was also observed in some of the lakes in the vicinity of Lincoln, Maine. Arthur H. Norton, of the Portland Museum of Natural History, states, in correspondence, that the plant is common throughout Maine. For future studies it would be of interest to determine whether or not any parts of the plant are eaten at seasons of the year other than the autumn.-Howard L. Mendall and JAY S. GASHWILER, Maine Cooperative Wildlife Research Station, Orono, Maine.

Black Vultures in southern Florida.—According to Howell ('Florida Bird Life', 1932), Black Vultures (Coragyps atratus) are less numerous in the southern tip of

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the peninsula of Florida than in the central and northern parts and are supposedly absent from the Keys. The writer spent seven weeks, January 17 to March 8, 1938, near the city of Miami and found Black Vultures fairly common, even outnumbering the Turkey Vultures at times, from Miami south to Homestead and across the Tamiami Trail as far west as Port Everglades. They were also noted on three occasions on the Florida Keys and one specimen, a victim of an automobile on the Tamiami Trail, was examined. Identification in the field was made easy in most instances because of the relative tameness of the birds, which were often seen standing along the side of the road waiting to resume feeding after the cars had passed. Fifteen field trips were made during the seven-weeks' period and birds of this species were seen on each occasion. Black Vultures were noted on the Florida Keys during a trip to Key West, February 9, 10, and 11. Four individuals were seen in Key West on the 10th and forty birds were recorded on the round trip.

A summary of the number of individuals of this species seen on the fifteen field trips, compared with the number of Turkey Vultures, is shown in the accompanying table giving the dates and localities for each trip.

Date		Locality	Black Vultures	Turkey Vultures
January	17	Miami	20	8
January		Port Everglades	60	10
February		Tamiami Trail	40	20
February	9	Miami to Key West	15	23
February	10	Key West	4	2
February	11	Key West to Miami	25+	25+
February	16	Dade County	6	45
February	17	Tamiami Trail Region	3	5
February		Tamiami Trail Region	26	48
February	21	Miami	17	26
February	23	Tamiami Trail Region	14	17
February	23	Homestead	25+	25+
February		Homestead	25+	25+
March	7	Miami Beach	4	2
March	8	Fort Lauderdale	6	11
Total	١	*******************	290+	292+

-JOHN C. JONES, Bureau of Biological Survey, Washington, D. C.

Swallow-tailed Kite in Connecticut.—Sage and Bishop's 'Birds of Connecticut' gives three records for this graceful and unmistakable bird (Elanoides f. forficatus) in Connecticut: summer 1861, July 2, 1877, and June 16, 1889. All these records are for the coast of the State, on Long Island Sound. On July 29, 1938, and again two days later, an individual of this species was seen soaring over a field in Litchfield township in the northwestern corner of the State. On one occasion it was seen perched on a fence-post at close range. Flushed, it flew effortlessly over the field, gliding close to the grass the way a Marsh Hawk (Circus) does, possibly in search of insects or snakes.—S. DILLON RIPLEY, Litchfield, Connecticut.

Hawk notes from Sterrett's Gap, Pennsylvania.—A picture of the fall migration of raptors differing in a significant way from that of Hawk Mountain on the same

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flyway is seen at Sterrett's Gap for the seasons of 1938 and 1939. Sterrett's Gap is a shallow wind gap on the Kittatinny Ridge between Cumberland and Perry Counties twelve miles west-southwest of the Susquehanna River and 'down' the ridge as the birds fly, seventy miles from Hawk Mountain. This is a region of broken and converging ridges immediately to the north of the Kittatinny and of two companion ridges just to the north and paralleling the Kittatinny; and in close proximity to it here but east of the river they begin turning away from it obliquely in a northeastward direction, gradually at first and at last more sharply until at a point due north of Hawk Mountain they are some miles distant. In all this region, the Kittatinny, as elsewhere along its course, is the only continuous ridge flanked on the south by the Kittatinny Vale, a broad valley, and on the north, more and more as it draws nearer to Sterrett's Gap, by numerous ridges and tumbling hills which are the beginnings of the Appalachian Plateau.

A careful comparison of the Sterrett's Gap records of the hawk flight with those of Hawk Mountain for the same seasons and days presents an extremely interesting and, I believe, significant result. The great differences that appear when the two records are compared I believe to be due to the presence of individual birds not seen at Hawk Mountain and to the absence of large numbers of hawks (perhaps 70% of the Hawk Mountain flight) that have drifted from the ridge in the intervening miles. These notes are presented to share with others this point of view.

First of all, individuals of the less-frequent species that appear along the flyway in migration and are counted at the two points do not seem to correspond. In general, the number of migrating raptors at Hawk Mountain is 35% greater than at Sterrett's Gap. The notable thing is that this difference is made by the greater numbers of the most-abundant species at Hawk Mountain. A check on the least-abundant species gives a different picture. The following table shows the relative frequency of the least-abundant species for the two years:

	Sterre	tt's Gap	Hawk Mountain		
	1938	1939	1938	1939	
Turkey Vulture	242	333	60	146	
Goshawk	21	18	9	29	
Rough-legged Hawk	2	4	-	7	
Golden Eagle	28	40	31	83	
Bald Eagle	15	24	37	64	
Osprey	74	89	124	174	
Duck Hawk	24	43	24	38	
Pigeon Hawk	6	21	12	43	

It will be noted that the statement made above the table is much more true of 1938 than of 1939. The differences shown in the table point to birds not seen at Hawk Mountain only when the Sterrett's Gap figure is very nearly equal to or greater than the Hawk Mountain figure. It is well known that many birds leave the ridge in the seventy miles between the two points, a factor which would account for the disparity in numbers at the second point. But where the figures very nearly equal or exceed those of Hawk Mountain the presence of other birds would certainly be indicated.

This would not be convincing evidence were it not for another discovery, namely, in the study of two species, Golden Eagle and Duck Hawk, it is evident that possibly 70% or better of the individuals of these species seen at Sterrett's Gap are not

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seen at Hawk Mountain. I am fully aware that this is an astonishing statement but the observations that follow leave me no choice but to make it. The typical case is that of the Golden Eagles for October 1, 1938. On that day the first Golden Eagles of the season for each place were tallied, four at Sterrett's Gap and four at Hawk Mountain. The eagles recorded at Hawk Mountain were: 1 adult at 9.15; 1 adult and 1 second-year bird at 4.10; 1 adult at 4.42. Those recorded at Sterrett's Gap were: 1 immature at 9.00; 1 adult at 9.52; 1 adult at 2.59; 1 second-year bird at 3.45. Three of these eagles could not possibly have been seen at Hawk Mountain. One, the adult tallied at Sterrett's Gap at 2.59, could have been the adult noted at Hawk Mountain at 9.15. Another and similar case in point is the comparative analysis of the Duck Hawks recorded for the first eleven days of October 1939. At Hawk Mountain the total for those days was eleven, at Sterrett's Gap seventeen or at least six Peregrines at our point that were not observed at Hawk Mountain. The times and days for these birds compared present a hodge-podge as does every effort for the least-frequent migrants. There are numerous incidents such as these two pointing always to the belief that only a small percentage of the Sterrett's Gap birds have flown past Hawk Mountain.

The best evidence of a differently constituted flight at Sterrett's Gap is found from a comparison of flight graphs depicting the intensity of flight at both places correlated with the dates. If the majority of Sterrett's Gap birds were the same as those of Hawk Mountain, the great flights there should affect the intensity of the flight at Sterrett's Gap on the same or the following day. Such seems to be generally the case but there are numerous and important exceptions. If a great flight should occur at Sterrett's Gap before one occurs at Hawk Mountain, then obviously the flight has little or no connection with Hawk Mountain since the migrants must pass Hawk Mountain before reaching Sterrett's Gap. On October 5, 1939, 1480 raptors flew over Sterrett's Gap. For the same day Hawk Mountain produced 439 birds with a total for the three preceding days of 440 as against the Sterrett's Gap total for the same three days of 68o. Assuming that all of Hawk Mountain birds were seen at our point (which is an absurd assumption on the grounds of every record we have) there are left 1281 hawks that were never tallied at Hawk Mountain. There are six other incidents of this same thing for the two Octobers of 1938 and 1939 alone. This presents a picture that is precisely the reverse of what we would expect if we assumed that the bulk of the Sterrett's Gap migrants had come past Hawk Mountain. To my mind this is the most unassailable argument in favor of my contention that the vast majority of the Sterrett's Gap birds represent a flight only remotely associated with Hawk Mountain.

The source of the Sterrett's Gap birds is not difficult to guess. It lies in the ridges independent of the Kittatinny that come closest to it in the vicinity of the Susquehanna River where they are in great profusion and confusion but finally narrow away northeastwardly in several well-defined ridges toward the northeast corner of the State. But the birds coming from this region, striking the Kittatinny flyway and passing over Sterrett's Gap, do not make up for the numbers that have drifted away southward from the flyway in the seventy miles separating Sterrett's Gap from Hawk Mountain. For this 1939 season the total in round numbers for Hawk Mountain is 23,000; for Sterrett's Gap, 14,000.

The problem is of course what percentage of Sterrett's Gap birds are not seen at Hawk Mountain. On the basis of the above notes and of many for which there is not space, all indications point clearly to a percentage well above fifty. It is difficult to accept this idea in view of our conviction of the limited hawk population of

northeastern North America. Yet accept it I, at least, must. I would be happy to hear from anyone interested in this problem and from anyone who has made observations that would throw some light by agreement or disagreement on the significance of these notes.

I am grateful to Maurice Broun of Hawk Mountain for permission to study his records.—Edward Snively Frey, 517 Hummel Avenue, Lemoyne, Pennsylvania.

Unusual nest of Killdeer.—On May 29, 1939, a nest with two eggs of the Killdeer (Oxyechus vociferus vociferus) was found in an unusual position at Langley Park, Silver Spring, Maryland, about two miles north of the District of Columbia line. A patterned brick walk, ten feet wide, leads from the house down to a small lake in a series of terraces and steps. On the lowest terrace at the edge of the steps and about twenty-five yards from the lake, the birds had taken possession of the top surface of a brick bruised by the frost, and had chipped the surface into small pellets and added small pebbles to make a 'nest' (see Plate 4, upper figure). The walk is constantly used by the family and the gardeners but the sitting bird displayed but little fear of mowing and watering going on within a few yards of it. Steps were immediately taken to protect the nest from marauders, and chicken-wire about eighteen inches high was placed around it supported by four wooden stakes. This precaution unsettled the bird so the stakes were removed and a small opening was left by which the bird could approach on foot. This method was successful and the bird sat on the eggs for several days.

On June 1, there were four eggs and a photograph was taken. On the morning of June 9 it was discovered that one egg was missing, probably due to a human predator. The wire netting had been displaced. At this time there was extreme heat with the thermometer up to 95° F. in the shade. The bird was observed on several occasions endeavoring to shelter the eggs by standing between them and the sun. The bird seems even to have realized that heat was too great for young to hatch, and on about June 11 the nest was abandoned.

During the time that the female (presumably) was brooding the other bird was constantly close by. Unfortunately pressure of other work did not permit of a close watch in order to see whether the male at any time took the female's place.—

L. McCormick-Goodhart, Silver Spring, Maryland.

Winter range of the Herring Gull.-The winter range of the Herring Gull (Larus argentatus smithsonianus) is given in the fourth edition of the A. O. U. 'Check-list' as "south to the Bahamas, Cuba, Yucatan, and the coast of Alabama and Texas." The inclusion of any territory outside the United States was based on very few records. Returns from banded birds indicate that the Herring Gull winters commonly throughout the Gulf region of Mexico, and occurs casually as far south as Panama. To date nearly a hundred recoveries have been received from Mexico, about half of them from the coast of Vera Cruz, mainly from the vicinity of the city of Vera Cruz, the Bay of Alvarado, and Puerto Mexico. Birds have also been captured near Alvaro Obregon, Tabasco, and on the coasts of Campeche, Yucatan, and Quintana Roo. The dates of capture range from August to April, but the majority were taken in January or February. Inland birds have been reported from Don Martin Dam, Coahuila; Coscomatapec, Vera Cruz; the district of Tulancingo, Hidalgo; Los Reyes Lagoon, eighty miles northeast of Mexico City; Chapala, Jalisco; and Lake Patzcuaro, Michoacan. The southernmost previous record for western Mexico is the Tres Marias Islands.

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McCormick-Goodhart: An Unusual Killdeer's Nest



KELSO: JUVENAL SCREECH OWL SHOWS AVERSION TO A CROW SKIN

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In 1926, Griscom (Amer. Mus. Novitates, no. 235, p. 7) extended the known range of the Herring Gull to Belize, British Honduras. Records in the U. S. Biological Survey extend the range to Panama. Two banded Herring Gulls have been reported from Honduras: one from the Beaver Islands, Lake Michigan, at Puerto Castilla; and one from Kent Island, New Brunswick, at Tela. Three Herring Gulls banded June 27, 1937, on Hat Island, Green Bay, Wisconsin, were found six months later in Guatemala, one at San Marcos in the northwestern part and two at Tiquisate in the southern part. Ten birds banded on islands in Lake Huron were reported about six months later at Puerto Barrios, Guatemala. At Rio Grande Bar, Nicaragua, on February 8, 1938, a Herring Gull was caught that had been banded as a young bird the previous June on Black River Isle, Lake Huron. Herring Gull B 611058, banded as a young bird July 20, 1930, at Isles of Shoals, New Hampshire, was shot December 10, 1933, at Bocas del Toro, Panama, our southernmost record to date. In the West Indies banded Herring Gulls have been taken in winter along the north coast of Cuba as far east as Nipe Bay; also on Cayman Brac, and near Kingston, Jamaica.

From this evidence it seems that the winter range of the Herring Gull in the 'Check-list' should be revised to read "south to the Bahamas, Cuba, Jamaica, and southern Mexico; occasionally south to Panama." This possibly indicates an extension of range in recent years, as well as more exact information on the subject.—MAY THACHER COOKE, U. S. Biological Survey, Washington, D. C.

Franklin's Gull in New York State.—On October 15, 1939, on the beach at Ontario Beach Park on Lake Ontario at the mouth of the Genesee River north of Rochester, New York, I found a dead Franklin's Gull (Larus pipixcan). The bird was almost completely in the first-winter plumage. Identification was definitely established at the Field Museum, Chicago, where the specimen is now preserved. The plumage was almost all present except on the breast and back where the bird had been torn open and completely eviscerated, apparently by Ring-billed and Herring Gulls which were present in large numbers. Because of the evisceration it was impossible to determine the sex. This is apparently the first recorded instance of this species in New York State.—Gordon M. Meade, M.D., 260 Crittenden Boulevard, Rochester, New York.

Gull-billed Tern breeding in Florida.—In his 'Florida Bird Life', Mr. Arthur H. Howell does not list the Gull-billed Tern (Gelochelidon nilotica aranea) as a breeding bird for that State. Indeed, the intimation is that the species is decidedly uncommon. He gives the record which added the bird to the State list, viz., that of a specimen secured by A. F. Mears on December 17, 1886, in Hillsborough County. This specimen is now in the Museum of Comparative Zoology. He then lists sight records of three other observers, which covers the information.

For the past two seasons, the writer has noted numbers of these birds along the highway from Lakeport to Lake Okeechobee, skirting the northern edge of the lake. Not then realizing its rarity, and the apparently complete lack of breeding records, he made no effort to locate a nesting colony. However, during June 1939, while investigating conditions in the lake, just off the mouth of the Kissimmee River, with Audubon Warden Marvin Chandler, I saw numbers of the birds, and Chandler casually mentioned that there was a nesting colony of "about one hundred pair" nearby! Sure enough, there was.

On the June trip, the eggs had all hatched and the young were hiding here and there in the grasses, while the adults hung overhead, uttering the characteristic

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cac-cac. With the meager photographic outfit possessed by the writer, no pictures were possible unfortunately. Not a hundred pairs were in evidence on June 27, but Chandler stated that the great majority had already dispersed. Breeding peak is late May and early June. In his present surroundings the writer has no access to a file of 'The Auk,' since Howell's book appeared (1932) so cannot state positively that this is the first nesting record for Florida, but that is entirely possible.—Alexander Sprunt, Jr., R. F. D. No. 1, Charleston, South Carolina.

Antipathy in the Screech Owl.—When five juvenal Eastern Screech Owls (Otus asio naevius) were taken from the nest and raised by hand in the course of a study at Cornell University, a peculiar antipathy was revealed which I have not noted in young of other birds. The word 'antipathy' is used here to mean an instinctive feeling of aversion or dislike.

Having been taken from the nest at the age of twelve to thirteen days, before their eyes were open, it was certain that they had not seen any other birds, except Robins and English Sparrows at a considerable distance, before they were sixty days old. Previous to this time it was found that both juvenal and adult Screech Owls were unresponsive to stuffed skins of their own and many other species of birds, including such enemies as the Goshawk, Barred and Horned Owls. On about their sixtieth day of life an ordinary cabinet specimen of the American Crow (Corvus brachyrhynchos), having the usual cotton-stuffed eyes and lifeless attitude, was carried into their room. Immediately all five displayed great horror in their owlish way, like Macbeth seeing Banquo's ghost. The skin was shown them many times that day, being simply held toward them in the hand, and evoked the same response, dread, then fear, then flight or fight.

If the skin was slowly thrust into view through the doorway the owls erected their ear-tufts and continuously uttered a loud chattering note which they usually give only when in a state of extreme anxiety. They would glare at the Crow with irises more contracted than was normal in proportion to the intensity of light in the room. When the skin came to within two feet of any one of the owls, the bird would crouch with wings and feathers spread in the defensive attitude characteristic of owls. As the skin came within reach the juvenal would either peck at the head with its bill (Plate 4, lower figure) or leap forward and strike the head of the Crow with both feet, and then fly to the opposite side of the room. Repetition of the experiment nearly every day for three months failed to lessen the intensity of this reaction. After the owls were five months old, however, the antipathy became less pronounced and was limited to the loud chattering. New surroundings or strange people inhibited their demonstration very little. The same aversion was shown to a Raven skin. The smallest owl showed slight fear of a Starling specimen.

The question naturally arose as to which characteristics of the Crow skin aroused the antipathy. Experiments indicated that the black color plus the slight animation imparted by the observer's hand to the object served to arouse the aversion. If the Crow skin were wrapped with thin white cloth so that color was changed while the original shape of the skin was retained, the owls would disregard it. Let only the front half of the Crow's head be exposed and their aversion would be asserted again. They would not show aversion merely to any black object or bird, as was shown by many trials with a variety of specimens. In addition, an element of vigor, the slight animation imparted to the skin when held in the observer's hand, was necessary to evoke their antipathy. When the specimen was laid on a stationary surface, such as a shelf or a bookcase, the owls would relax, and, later, sit near or

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walk over it. As corroboration on this point, it may be recalled that there is this same deference to relative vigor evident when owls are persecuted. A mounted decoy owl will attract more onslaughts from Crows and hawks if its wings or head are kept in motion by some mechanical device. During observations on the Barred Owl (Strix varia varia) (Kelso, Oölogist, 56: 16–18, 1939) it was noted that Crows would annoy the adults but would ignore the less vigorous juvenals.—Leon Kelso, Aurora, Colorado.

The scream of the Northern Barred Owl.—Early in the evening of November 29, 1939, I stood with Richard Stackpole, of Boston, at the edge of Crooked Pond, Boxford, Massachusetts. Having tried without success for several minutes an imitation of the usual Barred Owl's hooting I took out of my pocket a small wooden whistle. The pitch of this whistle is so penetrating that I customarily hold my fingers in my ears while blowing.

Back upon the first blast from the whistle, so quickly that my first reaction was that I was hearing an echo, came the rather rarely heard scream of a Barred Owl (Strix varia varia) followed immediately by the usual, 'Who cooks for you? Who cooks for you all?' The bird was apparently on the hillside rising from the other shore of the pond and probably not over 150 yards distant, at the most.

Mr. Stackpole and I agreed that the pitch of the answer was identical with the pitch of my whistle. The following day, therefore, I established the pitch of my whistle by comparison with a piano. Pitch was the 'B,' one note below high 'C.'—WENDELL TABER, Cambridge, Massachusetts.

Saw-whet Owls at Philadelphia, Pennsylvania.—The Saw-whet Owl (Cryptoglaux acadica acadica) is regarded as an irregular winter visitant in the Philadelphia region. In 'Field Notes' of 'Cassinia,' there are eight published records of the occurrence of this species around Philadelphia from August 1930 to July 1937.

This autumn, 1939, a comparatively heavy influx of these birds has taken place in and near Philadelphia. On October 30, 1939, a dead bird was picked up at 17th and Walnut Sts., in downtown Philadelphia by Quinton Kramer. One bird was seen at Bustleton, Philadelphia, by William Yoder on November 19, 1939, and was captured by hand and banded. About three miles distant, Yoder found another at Holmesburg, Philadelphia, the same day; and this was also taken and banded. Another record on that same day, November 19, 1939, was a bird found in a very small honeysuckle thicket at Frankford, Philadelphia, by James B. Wright. At Fairmount Park, in Philadelphia, Millard Lindauer observed one bird on November 25, 1939. On November 26, 1939, Lindauer found another bird at Mt. Holly, New Jersey. It is well that the Holmesburg bird was banded because, on December 3, 1939, the writer found another bird in the same thicket without a band. This bird was promptly banded. On December 17, 1939, the writer picked up a freshly killed specimen on the highway at Hartford, New Jersey. The same incident occurred when Kramer found a dead bird along the road at Eddington, Pennsylvania, on December 24, 1939.

It can be seen that, in these modern times of automobile conveyance, there is a definite mortality of Saw-whet Owls resulting from their being struck by cars. It has been gathered from Richard F. Miller that the depleted ranks of Screech Owls, as compared to their relative abundance in former years, is partly due to increased traffic of automobiles. It seems obvious that this situation would affect the Saw-whet Owls as well.

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From observations gathered here, it appears that the Saw-whet Owl, on its winter habitat, is constantly wandering from one locality to another. In very few instances, a second sight record of a bird has been obtained in the same thicket where it was first found. From the scarcity of mid-winter records, it seems that the bulk of the birds pass to the south of us to winter.

It has been my experience and I have gathered from others that, around Philadelphia, these birds are usually found in honeysuckle tangles. There was one exception, however, of a bird having been found in a dense nursery grove of young pines.—EDWARD J. REIMANN, 2261 E. Kennedy St., Philadelphia, Pennsylvania.

Saw-whet Owls in Kentucky.—On October 21, 1939, while searching for golden mice (Peromyscus nuttalli nuttalli) at Rodburn, two miles east of Morehead, Rowan County, Kentucky, it was the good fortune of the writer to capture an adult Saw-whet Owl (Cryptoglaux acadica acadica). When first seen, the owl was sitting about six feet from the ground in a small sweet-gum tree. It was sound asleep, and was captured by hand before it was aware of what was transpiring. The owl was found near the center of a damp, dense thicket, covering approximately five acres. On one side the thicket was bounded by a small stream. The dominant woody plants of the thicket were pitch pine (Pinus rigida), yellow pine (Pinus echinata), scrub pine (Pinus virginiana), common sumac (Rhus glabra), dwarf sumac (Rhus copallina), red maple (Acer rubrum), blue beech (Carpinus caroliniana), sweet gum (Liquidambar styraciflua), sycamore (Platanus occidentalis), and American beech (Fagus grandifolia). Green briars (Smilax rotundifolia) were very abundant in the area, and had grown up into the bushes, making a very dense thicket.

The writer attempted to keep the bird alive, but found it would eat only live mice. Due to stress of other duties, it was impossible to capture enough mice, so the owl died on October 30, 1939, and the skin is now No. 554 in the Morehead State Teachers College Museum at Morehead, Kentucky. This is apparently the first record of the occurrence of this little owl in Kentucky.—Roger W. Barbour, State Teachers College, Morehead, Kentucky.

Red-headed Woodpecker nesting in New Hampshire.—In the summer of 1939, a pair of Red-headed Woodpeckers (Melanerpes erythrocephalus) occupied a recently lumbered area close to the village of Fitzwilliam, New Hampshire, and raised a brood in one of the dead trees not leveled by the hurricane of September, 1938.

The first report was the observation of one bird on June 18 by Mrs. Sturgis Coffin, who was attracting many other species to her suet and feeding trays. This record was confirmed by Mr. Wendell Taber on June 24, when both birds were seen. The eggs were hatched by July 17, when the writer's daughter Margot, with a small and lady-like hand, could feel the young at the bottom of the ten-inch hole in the tree. The birds were quiet and not shy, in spite of being under constant supervision of Mr. George Haydock and his eager groups of young campers from South Pond Cabins. The parents brought the young birds out of the nest on August 3, and gradually introduced them to the insect colonies in the neighboring trees. For several days the two adults and two young were counted, but on August 25, five birds were counted. All five were seen almost daily until September 4, when the writer left town. It is impossible to say whether the fifth bird was a new arrival in the area or a third young which had for some reason been overlooked.—Roger C. Fenn, Concord, Massachusetts.

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Acadian Flycatcher flies backward.—Because it seems to be a popular belief that the hummingbird is the only bird capable of flying backward, it seems worth while to record the fact that the Acadian Flycatcher (Empidonax virescens) has been observed to perform this feat very neatly and apparently very easily.

While in the vicinity of a nest of a pair of Acadian Flycatchers in the summer of 1937, the writer noticed one of these birds poised in the air facing a large insect (probably the big syrphid fly, Milesia virginiensis) also poised in mid-air facing the bird. The two were only three or four inches apart and each seemed to be regarding the other with fixed attention. Except for their rapidly vibrating wings they were practically stationary in the air. However, the insect appeared to be the more aggressive of the two, for shortly it began a slow advance, while the flycatcher retreated at the same rate, flying backward without apparent effort, while still facing the fly and maintaining the same distance from it. This lasted for only a few seconds, when the insect darted off and the bird sought its familiar perch.

This observation was made without the aid of glasses, at a distance of from fifteen to twenty feet, without any obstruction to clear view. It recalled at once the deft flight of the hummingbird as it backs away from the flower which it has just been probing. The flycatcher executed this maneuver so readily that the writer has not much doubt but that it could as easily duplicate other aërial feats for which the hummingbird is famous.—Arthur B. Williams, Cleveland Museum of Natural History, Cleveland, Ohio.

Key West Vireo at Miami, Florida.—On February 16, 1938, the writer collected an adult male Key West Vireo (Vireo griseus maynardi) along the bank of a drainage canal, twelve miles northwest of Miami, in Dade County, Florida. The locality is over forty miles from the Florida Keys, the typical range of this race. The specimen was examined and identified by Dr. H. C. Oberholser and is now in the collection of the Bureau of Biological Survey.—John C. Jones, Bureau of Biological Survey, Washington, D. G.

Territorial aspects of the American Redstart.-During the course of about thirtyfive cruises over four seasons for a census of the breeding birds in a heavily wooded slope in Westchester County, New York, the writer found Setophaga ruticilla to be a highly territorial species. Males advertised their presence by their typical wellknown song and by formalized territorial displays that apparently served to define boundaries and reduce fighting. These displays consisted of short, horizontal, semicircular flights made with stiffened wings and out-spread tails. These performances were frequently observed between males, less commonly between females and never between a male and a female where a question solely of territory was involved. Hingston's interpretation of the function of warning coloration in plumages seemed to be particularly applicable in these cases. Low, repeated quit, quit notes could be heard when the displays were concluded and the birds returned to their perches. As far as could be observed, these same performances seemed to serve as some part of the male's courtship of females. On all exciting occasions, of course, both sexes spread their tails like many other American wood warblers. Flight songs appeared to be absent. Singing perches, if present, were largely undetected by the observer. One male which took up territory in a blackberry-locust association sang frequently on April 30 and May 8 only one to two feet from the ground. Three, males were once watched for an entire morning before females had arrived on the area: one was quite obviously patrolling the boundaries of his territory, the two others seemed to be moving back and forth on an indefinite and irregular axis, which approximated the length of their territories.

A special effort was made in 1937 to learn the number of unmated males. Twenty. four occupied rigidly fixed territories on the study area. Twenty of these birds were definitely mated. Of the remaining four, one held its territory until at least June 13, another until at least June 19, a third until June 20, and a fourth until June 26, If all four, or even half of these were unmated, the percentage of paired birds would be between 83 and 91. This figure is comparable to the 85 per cent found by Mrs. M. M. Nice for Song Sparrows, but like most American studies, it is higher than the remarkable percentages reported by British investigators: 45 per cent for Nightingales, 60 and 70 per cent for Chiffchaffs, and 80 per cent for English Robins and Willow Warblers. In the case of the American Redstart, an indeterminate number of unmated wandering males also exist. Without banding, these are extremely difficult to detect in the adult plumage. By plotting the position of all birds on a map, one such bird was discovered on June 13. On the same day, a male in the immature plumage spent the entire morning softly singing and gradually working its way along 800 yards at the top of the ridge. This bird was furiously driven off by males and females whenever it passed through their territories. Plumage notes on 48 males on territory showed that only four (8.3 per cent) were in immature plumage. All four were paired and possessed territories of the same size as those of the adult

The size of territories was usually about one acre or less, but in one instance was compressed to about half an acre. Approximately twenty-two pairs (or males) each year occupied the 39.93 acres under investigation. Their boundaries were observed in two cases to break down on June 17, when young were being fed in the nest. Interspecies competition or jealousy were seldom in evidence. Redstarts and Ovenbirds were the two most dominant species of the slope and both would sing in the same tree without the slightest evidence of hostility. The former was once seen briefly fighting with a Black and White Warbler. Males were silent in the presence of female Cowbirds, but females reacted with sharp hisses, a rapid snapping of the bill and much spreading of the tail.—Joseph J. Hickey, c/o Consolidated Edison Co. of N. Y., 4 Irving Place, New York City.

Bobolink rises from ocean surface.—During the spring of 1939, I observed an extremely unusual manifestation of bird migration on the eastern coast of Florida. Early in the morning of April 28, I arrived on an offshore bar protecting the coast of Riviera, Florida. Settling near the surf, I watched a stream of small, isolated flocks of passerines and Icteridae pass over the surf, coming from almost due east. Their origin was presumably Settlement Point, Great Bahama Island, which is about sixty miles due east of Riviera. None of the flocks was lower than one hundred feet.

Several hours after my arrival and while the flocks were still in passage, I discovered an unfamiliar object floating on the surface of the ocean about fifty feet beyond the surf. Using my eight-power binocular I was amazed to see a male Bobolink (Dolichonyx oryzivorus) riding the swells with both its head and tail held at right angles to the surface. Occasionally its back would appear above the water. I had not been looking in this direction for some time and did not witness the initial appearance of the bird. For a few seconds it remained very still, then it began to struggle vigorously for several seconds, finally leaving the water directly without pattering along in coot fashion. After flying very weakly across the beach, it

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dropped into an extensive clump of beach reeds about two hundred feet back from the shoreline, where I was unable to locate it.

Knowing of no similar observations, I endeavored to determine whether any reliable reports of this nature were available. I have found none involving landbirds, although Mr. Roger Tory Peterson has written me of an observation made by him which might be placed in the same category. He writes, "On one occasion I saw a Spotted Sandpiper rise from the surface of the water. This bird had, oddly enough, a collision with another sandpiper going in the opposite direction, believe it or not! It dropped below the surface of the water, rose up, rested for a moment and then flew."—Vincent Everett Shainin, Columbia University, New York City.

Bullock's Oriole in Thibodaux, Louisiana.—On February 1, 1939, I observed a strange female oriole in a garden in the town of Thibodaux, Louisiana. On February 5, it was found dead. The bird was a female Bullock's Oriole (Icterus bullocki) the first of its species to be recorded for Louisiana. Identification was made by Professor George G. Williams of Rice Institute, Houston, Texas, and confirmed by Dr. Harry C. Oberholser of the Biological Survey, Washington, D. C. The specimen is now in the Louisiana Department of Conservation Museum in New Orleans, Louisiana.—Ava R. Tabor, Thibodaux, Louisiana.

Hosts of the Cowbirds.—A few of the records of the parasitic cowbirds in the oölogical collection of the A. M. N. H. represent additions to the scrupulous lists of known hosts published by Dr. Herbert Friedmann in his monograph, "The Cowbirds' (1929), and in supplementary articles in the periodical literature. The new or unusual hosts are:

Mimus 1. longicaudatus.—A nest of this mockingbird found near Lima, Peru, on February 6, 1913, contained two eggs of Molothrus bonariensis occidentalis and two of the host. This is an addition to the several species of mockingbirds known to be parasitized by the Shiny Cowbird. The specimens were collected by Mr. R. H. Beck, who at that time was leading the Brewster-Sanford Expedition.

COOPER'S TANAGER, Piranga rubra cooperi.—A set of this species taken near Tucson, Arizona, on July 3, 1922, contains two eggs of the Bronzed Cowbird (Tangavius aeneus aeneus). This is the second such record for Cooper's Tanager, and the first within the United States. These eggs, now in the P. B. Philipp collection at the A. M. N. H., were collected by Mr. H. H. Kimball.

Texas Sparrow, Arremonops r. rufivirgatus.—Two eggs of the Red-eyed Cowbird, Tangavius aeneus involucratus from the George B. Sennett collection are accompanied by data indicating that they were taken in a nest of this sparrow. The eggs of the host, unfortunately, are not with them, although they may have been sent in separately as there is a set of similar data in the collection. J. B. Bourbois collected these eggs in 1879 at his Lomita Ranch near Hidalgo, Texas. This seems to be the only evidence that the Texas Sparrow is sometimes a victim of the Red-eyed Cowbird.—Dean Amadon, American Museum of Natural History, New York City.

Alabama Towhee in northeastern Florida.—Early in the spring of 1938, from March 11 to 28, large numbers of migrating towhees were seen near the mouth of the St. Johns River, in the vicinity of Mayport, Duvall County, Florida. A specimen taken by the writer on March 12 proved to be an adult male White-eyed Towhee (Pipilo erythrophthalmus alleni), the common breeding variety of eastern Florida. A second specimen, however, collected on March 18, was found to be an adult male Alabama Towhee (P. e. canaster), normally found in the western part of the State

and, so far as known, unreported in migration from the Atlantic coastal region. Both specimens were examined and identified by Dr. H. C. Oberholser and are now in the collection of the Biological Survey.—John C. Jones, Bureau of Biological Survey, Washington, D. C.

Winter roosting habits of Slate-colored Juncos.—In the afternoon of March 19, 1937, I set a number of traps for shrews about the Taxus thickets in the woods a few miles east of Ithaca, New York. There was some snow on the ground, but much had melted during the day, leaving bare patches in the woods beneath the hemlocks and leafless hardwoods. During the evening the traps were visited in expectation of securing live shrews. While none was secured, my efforts were not wholly without reward. When examining one trap about 9 p. m., I observed five juncos, Junco hyemalis hyemalis, roosting on the ground at the base of a Taxus thicket. The birds did not take immediate alarm, but allowed me several moments for close inspection at a distance of several feet. They had chosen the site with care, for the chamber was well protected from rain, snow and wind. I had not previously seen juncos in this rather dense wood stand, although neighboring open fields usually supported a few birds. Perhaps where such shelter is available, this species commonly resorts to the Taxus thickets with the approach of nightfall.

That they are not immune from the attacks of small predators even in such situations is attested by finding the feathers of small birds in the stomachs of deer mice (Peromyscus leucopus noveboracensis) in the same habitat. While the feathers were not recognized as those of a junco, it seems probable that the small ground-roosting species must be susceptible to the attacks of these ubiquitous rodents and the larger shrews.—W. J. Hamilton, Jr., Cornell University, Ithaca, New York.

Harris's Sparrow in central western Illinois.—In checking over old records, from Adams County, Illinois, I find one report of a Harris's Sparrow, Zonotrichia querula, previous to 1910. The migration course of this bird formerly was considerably west of Quincy.

I reported a stray occurrence in 1913, another in 1923; and in the spring of 1936, H. L. Angus captured a mature male in one of his bird-banding traps. This seemed to be the forerunner of a very decided drift which for two years has been increasing in intensity each spring and fall.

In the spring of 1939, I banded twelve Harris's Sparrows and saw no fewer than twenty-five or thirty additional birds which remained in the woods of my Nature preserve for a period of two weeks. Russell Davis of Clayton, Illinois, twenty-eight miles east of Quincy, has been capturing Harris's Sparrows regularly for the past eight years. These birds enter traps readily and feed upon fine-chopped corn, hemp and millet. The advent of this species has been a welcome addition to the lists of bird lovers in this locality.—T. E. Musselman, Quincy, Illinois.

Correction.—Through misunderstanding, the final paragraph of my note on "Two new breeding birds for the United States' (Auk, 57: 117, 1940) was omitted. This is: "I am indebted to Dr. H. C. Oberholser of the Bureau of Biological Survey and to A. J. van Rossem of the Dickey collections, California Institute of Technology, for the loan of specimens for comparison; to George H. Lowery, Jr., for a copy of his recent paper on the Cassidix mexicanus group; and to Ludlow Griscom of the Museum of Comparative Zoology for the measurements of the 1905 kingbird." It was this assistance which made possible a critical determination of the specimens secured.—Allan R. Phillips, University of Arizona, Tucson, Arizona.

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Correction.—In my recent paper "The Bird Life of the Grand Manan Archipelago" (Proc. Nova Scotian Inst. Sci., 19: 293-372), Francis H. Allen is misquoted as reporting that White-breasted Nuthatches (p. 356) were "abundant" on Grand Manan between August 14 and 27, 1929. This statement should apply to Red-breasted Nuthatches (pp. 356-357).—OLIN SEWALL PETTINGILL, JR., Carleton College, Northfield, Minnesota.

The Winter of 1939-40.—Believing that some record should be made of the bird mortality due to the unusual winter weather of the past season, as well as of other unusual occurrences caused by these conditions, the Editor of 'The Auk' would welcome brief notes bearing on the subject, to be gathered under a general heading in the July issue.

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### RECENT LITERATURE

\*\*Chapin's 'Birds of the Belgian Congo,' Vol. 2.—The first part of this great work' was issued in 1932 and reviewed the following year in this journal (Auk, 50: 237-240, 1933). The material in the present volume, as in the two still to come, is, of course, the basis of much of the geographical, ecological, and evolutionary discussion so ably developed in the first volume, and continues the treatment of the birds from the rails through the woodpeckers. A colored plate of the Congo Peacock, Afropavo congensis, which was not discovered until some years after the appearance of the first volume (where it belongs systematically) serves as frontispiece and not only links the present volume with its predecessor, but also acts as a graphic reminder of the ornithological activity of the intervening seven years.

The present volume contains 632 pages, 21 plates and 38 text-figures, and treats of 526 forms with comparative notes on at least as many more. In each case a full bibliographic synonymy, as far as the Belgian Congo is concerned, is given, followed by a list of the specimens collected by the American Museum Congo Expedition, notes on the colors of the soft parts, a detailed account of the distribution of the species, and terminating with the unusually full field notes and observations made by the author during his long stay in the Congo.

The systematic and distributional treatment is not only full and carefully done, but it is based on practically all the pertinent material in the leading museums of Europe and America and is, therefore, a reflection of all that is known, and not, as is so often the case, of merely a particular part available to an author. The ecological and life-history material are largely data new to the sum of printed information and are in some ways the most valuable part of the work, as it is so much easier to obtain specimens than facts. The accounts of such forms of unusual interest as the Standard-winged and the Pennant-winged Nightjars, the Common and the Lyre-tailed Honey-guides, the White-thighed Hornbill, and others, are veritable papers in themselves.

Of the twenty plates other than the frontispiece mentioned above, two are in color and represent two species of small rails of the genus Sarothrura, and are from the brush of the late Louis Agassiz Fuertes; the others show captive or freshly killed birds of species treated in the text, and also some of their nests. A good index completes the volume.—H. FRIEDMANN.

Allen's 'Sex and Internal Secretions.'—The purpose of the first edition of this work, which appeared in 1932, was to "survey the most important recent researches in problems of sex, especially those concerned with internal secretions, in order that concepts already established by experimental evidence may be clearly stated and made readily available." The enlarged 1939 edition<sup>2</sup> summarizes and makes available a great deal of the more recent work.

While the major portion of the book deals with other animals, there are here summarized several hundred papers on experimental work on birds. Many of these are not generally available to most ornithologists and therefore this summarizing volume should prove useful to those who teach ornithology as well as to those conducting research. Most of the bird material naturally deals with

<sup>&</sup>lt;sup>1</sup> Chapin, James P. 'The Birds of the Belgian Congo' / Part II / Bull. Amer. Mus. Nat. Hist., vol. 75, vii + 632 pp., 21 pls., 38 text-figs., Oct. 27, 1939.

<sup>&</sup>lt;sup>2</sup> Allen, Edgar [Editor]. Sex and Internal Secretions. A Survey of Recent Research. 8vo, xxxvi + 1346 pp., 3 colored plates, 422 black and white illustrations and many diagrams, April, 1939; The Williams and Wilkins Co., Baltimore, Md. Price \$12.00.

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domestic species or others easily kept in captivity. The emphasis is on secondary sex characters and egg-laying. It is as natural that many investigators should resort to birds as experimental subjects because of their highly evolved secondary sex characters as it is that Lorenz and others should utilize birds because of their highly developed instincts.

The book is divided into five sections containing a total of twenty-four chapters, each written by a specialist in the field which is covered. There is a bibliography, sometimes amounting to several hundred references, appended to each chapter and nearly three-quarters of the chapters contain references to birds.

The only portion dealing exclusively with birds is Chapter 5, by L. V. Domm, which summarizes a great deal of experimental work on 'Modifications in Sex and Secondary Sex Characters in Birds.' Here, for example, are some of the reported effects of gonadectomy: castrated Black-headed Gulls retain the 'winter' plumage thereafter; in the Ruff, the seasonal tubercles of the head do not develop after castration; in ovariotomized examples of one of the weaver finches, any feathers which regenerate during the breeding season are male feathers, but these are replaced by normal female feathers at the fall molt; castration does not modify seasonal plumage changes in the Indigo Bunting, while castrated Mallards never have an 'eclipse' plumage, but go from one breeding plumage directly into another. There is much of interest in this chapter on the experimental modifications of feather pattern in the Domestic Fowl, and many other birds are also dealt with. This chapter is 100 pages long and concludes with a bibliography of over 300 references.

In Chapter 9, by Carl G. Hartman, are summarized the data on 'Ovulation, Fertilization and the Transport and Viability of Eggs and Spermatozoa' for the various classes of vertebrates. Among other things here we learn (p. 632) that Domestic Hens, when suddenly confined in close quarters, have been reported to cease laying for a time and may resorb the remainder of a clutch of occytes. This is interesting in connection with the well-known fact that many wild species seldom or never lay when reduced to captivity; nor have experimental hormonal injections as yet satisfactorily overcome this state of affairs. The same chapter (p. 650) deals with Riddle's work in determining the time of ovulation in the sexual cycle of pigeons, as well as similar work by Phillips and Warren on the Domestic Fowl. Hartman reports that similar time relationships for all lower vertebrates appear as yet to be unknown. Farther on (p. 695) are summarized the few known facts regarding the viability of sperms in the genital tracts of hens, ducks and Ring Doves. It appears that all authors agree that no egg that is laid within twenty-four hours after the first mating is fertile, while the number of days thereafter during which the female in isolation may lay fertile eggs appears to be quite variable. Other chapters also contain many items of interest on the endocrinology and physiology of birds.

The literature on sex and internal secretions grows so rapidly that we wonder if the editor will be able to keep another edition down to the size of one volume! The book is well printed and indexed and contains few typographical errors.—RALPH S. PALMER.

Craigheads' 'Hawks in the Hand.'—This little book' is an interesting combination of the extremely ancient and the very modern. The art of falconry, or hawking, goes back to the remote or unwritten past, whereas photography by contrast is so

<sup>&</sup>lt;sup>1</sup> Hawks in the Hand: Adventures in Photography and Falconry. By Frank and John Craighead. Small octavo, 291 pp., 57 illus. (half-tones from photographs by the authors), Boston & New York, Houghton Mifflin Company, 1939. \$5.50.

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thoroughly a thing of today that any attempts to follow its very latest developments must be done through keeping up with day by day current events. Written by twin brothers twenty-three years old and sons of a Government scientist, this volume opens with the narration of the finding and capture by the authors several years ago of their first wild pets, a nest and the young of the Barred Owl in the Virginia woods along the Potomac River near Washington, D. C. Soon after, they became interested in taxidermy and practiced on Crows and Starlings and later on a Barred Owl, the killing of which later filled them with regret. Some attempts at shooting a Red-shouldered Hawk led them to abandon the practice of killing birds, but, instead, to take up the study and training of living birds. The reading of an article on falconry in an old issue of the 'National Geographic Magazine' led the authors to the study of all available books on this old, mystic art. Stimulated by their studies, by the acquisition of a pair of climbing-irons, and the coming of springtime, the brothers engaged in a series of extensive operations along the shores of the Potomac River near Washington, in various areas in Pennsylvania and elsewhere, with such birds as Cooper's Hawk, the Broad-winged Hawk, and numerous other birds. They secured data on such matters as the care and the training of hawks of various species; the use and value of the hood; flying to the hand and flying for food; experiments in tree-climbing to nests, and the like. There is detailed discussion of capture and subsequent slow, patient training of the various species of birds with which they worked, and much information was obtained and is recorded here on life history and habits, relative flying abilities and individual peculiarities, with the narration of numerous incidents illustrative of these and other attributes. All these observations of trained birds soon aroused in them a desire to know more of the habits of wild birds to compare with those of the trained birds. This led to the building of observation blinds near the nests, accomplishments that in turn led on to intensive study of nature photography. Starting with inexpensive photographic equipment and working very slowly with readily available subjects, their progress can be traced from year to year, through numerous failures, mishaps and blunders, with huge toil and pains, to the preparation of the pictures of unusual excellence which are given in the book. Its various chapters furnish detailed accounts of activities over a gradually widening field, such as the adventurous descending by rope out over Potomac River cliffs to get pictures of Duck Hawksa performance done over and over again later on in other localities; making studies of the habits and securing photographs of the young of the Bald Eagle; searching for, and obtaining movies and stills of such birds as the Great Horned Owl, the Northern Raven, the Barn Owl, Cooper's and Sharp-shinned Hawks and the like. In addition to the birds already mentioned, there are chapters devoted to their work with the Sparrow Hawk, the Screech Owl, the Pigeon Hawk, the Osprey, the Long- and the Short-eared Owls, the Burrowing Owl, the Prairie Falcon and the Golden Eagle. There is also a chapter devoted to bird photography in which are given lists of needed equipment and valuable notes thereon based upon their own experience in practical field use of different types of apparatus, particularly with the two general sub-divisions of tree and cliff photography, of the use of blinds, and of adjustments and problems pertaining to insufficient light or to changes in light conditions. The subject of the protection of these birds also is given appropriate attention throughout the book: there are entirely too many sportsmen who think of the birds under consideration as being only something to kill. In this volume their better attributes are stressed-in fact one of its main objectives appears to be a general appeal for their protection.

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his apOn the whole, the book is a thoroughly creditable production, particularly when the factors of the youth of the authors and the difficulties under which they worked, are considered. A performance of this kind tends to strengthen one's optimism and to increase one's faith that there still abide in our American youth the good old-fashioned, wholesome, sterling qualities that in the past have made America great.—J. S. WADE.

Canby's 'Thoreau.'-The steadily growing popularity of the writings of Henry David Thoreau (1817-1862), American naturalist, educator, poet and philosopher, is a source of gratification to the steadily growing number of readers who appreciate and enjoy them. As has been frequently pointed out, during his life-time Thoreau was comparatively unknown and such of his works as had been published had an exceedingly limited circulation. In the seventy-seven years which have elapsed since his death, much hitherto unpublished material by him has been issued, and his writings and his unique philosophy of life, decade by decade have spread abroad until he has become known and his writings have been loved in every important country of the world. It will be remembered that it was in the fields and woods of his birthplace, Concord, Massachusetts, that he learned the love and worship of Nature which later became a great passion of his existence. Of these he has written in phraseology of such exquisite beauty that presently it becomes like a haunting melody in the memory of his readers. A graduate of Harvard University, he was a valued friend of the famous naturalist, Louis Agassiz, and made various biological collections for him. In 1845, Thoreau began his now famous experiment in simplification of living. He retired to a self-built hut in the woods by the shores of Walden Pond near his native village, and there for two years he made studies and wrote of birds and plants, insects and other animals, and of the various philosophical and other themes in which he was interested. At various times he also made explorations to other places, notably to Canada, Maine, Cape Cod, Minnesota and elsewhere, and wrote of most of these in detail, with intermingling of factual and mystical observations of Nature. He never married, but one of the great friendships of his life was with Ralph Waldo Emerson, and they were of life-long inspiration to each other. Thoreau died of tuberculosis at the early age of forty-five, and his remains rest today in the Sleepy Hollow Cemetery at Concord, Massachusetts, near the grave of his associate, Emerson. All these and many other facts pertaining to Thoreau's career have been narrated with great fidelity to detail in the newly issued biography1 by Dr. Canby. The principal biographies of Thoreau which appeared in the years after his death and with the increase of his fame, were those by Emerson, 1863; Channing, 1873, revised 1902; Page, 1877; Japp, 1878; Sanborn, 1882, revised 1910; Salt, 1890 and 1896; Marble, 1902; Van Doren, 1916; Edward W. Emerson, 1917; Sanborn (a second and larger biography), 1917; Bazalgette, 1924; Atkinson, 1927; and Crawford, 1934. Since there is always room on our Thoreau shelves for still another volume of this type when of genuine excellence, it is a pleasure to welcome this latest addition, the product of long years of research and toil on part of its distinguished author. It is a delightfully written, well-balanced, well-rounded, well-documented production. It is predicted that it will prove to be one of the outstanding biographies of the year. It is not unlikely that, through its well-deserved popularity, it may serve to introduce thousands of new, appreciative readers to the charms of Thoreau's own writings. If so, all such

<sup>&</sup>lt;sup>1</sup> Thoreau. By Henry Seidel Canby. 8vo, 508 pp., 16 illus., Boston and New York; Houghton Miffin Co., 1959. \$3.75.

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would be under a lasting debt of gratitude to Dr. Canby. There is something very touching and very appealing in the author's delineation of this great and noble-hearted man and the pathos of his struggles to fill the emptiness and the loneliness of his own life with studies, assiduously pursued, of birds and insects and flowers and "the sweet mysteries of nature"—all as part of his greater quest: his explorations for God and for spiritual reality. There are many others in the world who likewise have lost and are seeking their own "hound, bay horse and turtle-dove." To all such, the reading of Dr. Canby's book is heartily commended.—J. S. Wade.

Dr. Strong's 'Bibliography of Birds.'-The enormous output of ornithological literature from year to year places an ever-mounting burden upon the ornithologist who would keep abreast of the progress of knowledge in his special field. Of the various aids currently available, the annual summaries now provided by the 'Aves' section of the 'Zoological Record' are by far the best, but the older literature is less thoroughly treated in these, while for that of recent decades the search through the yearly volumes is a slow and laborious undertaking. For this reason, and because a single all-inclusive index to ornithological literature is at present almost out of the question, special bibliographies covering part of the field are of immense practical value. Such a one is that here presented by Dr. Strong. As its subtitle indicates, it has been prepared "with special reference to anatomy, behavior, biochemistry, embryology, pathology, physiology, genetics, ecology, aviculture, economic ornithology, poultry culture, evolution, and related subjects." The two volumes1 now issued comprise some 900 pages containing (at an average of twenty-five references to a page) at least 22,500 titles, and are the result of many years of painstaking search.

Because of this limited field, purely taxonomic works are for the most part omitted, though many, if of monographic scope, are included. Palaeontology is already well covered by Lambrecht's catalogue of 1921, so that such papers are omitted except from that date to 1926, the year set as the limit in general of literature listed. Parasitology is largely referred to various excellent bibliographies while "the vast field of poultry economics and management," though well represented, is not completely covered. Works on migration have been selected with a view only to their importance and in general the aim has been to include such titles as seemed likely to be of probable use. These explanations account for the omission of many important works that one might otherwise have expected to find listed. Furthermore, since the work was in progress for a number of years, the compiler's viewpoint has varied from time to time and he acknowledges that a strictly consistent policy has not been possible, but "all reasonable efforts have been made to secure and check references to old or obscure publications that might have any possible use to the investigator," a difficult undertaking at best.

In addition to the titles of papers, the full names of authors, their life dates, and references to their biographies and bibliographies where published, are given. The introductory pages explain the methods employed in citation. A key list of abbreviations to periodicals cited, with their full titles covering some fifty-five pages, gives a little idea of the extent of the search made through ornithological literature. In addition is a list covering ten pages of the titles of minor or ephemeral periodicals, poultry journals and others, that have not been included.

<sup>&</sup>lt;sup>1</sup> Strong, Reuben Myron. 'A Bibliography of Birds with special reference to anatomy . . . and related subjects.' Zool. Ser. Field Mus. Nat. Hist., vol. 25, pt. 1, pp. 1–464; pt. 2, pp. 465–987. December 1939. \$11.00.

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From a standpoint of mechanical style, much pains have been taken to facilitate ready reference within a minimum of space. The titles are arranged in double column on the pages, with omission at times of unnecessary parts; Arabic numerals are uniformly employed, and usages already familiar in standard bibliographies are for the most part followed. A helpful feature is the indication by means of initial letters, of the library where some of the less common publications were consulted. The names of authors and the date of each paper are in bold-face type as paragraph headings, but it appears that the former would have stood out better had the numerals been in Roman type instead. To the reviewer's eye also the capitalization of English common nouns, pronouns and verbs in titles makes reading less easy. In a work of this nature, proof-reading is unusually difficult, but has been remarkably well done, and in many respects the bibliography is a model of its kind. The only important slip noticed is listing of J. Cossar Ewart's paper on down plumages under 'Cossar, Ewart J.' It may be mentioned also that (Capt.) C. C. Abbott who wrote on the fauna of the Falkland Islands in 1861 is not the (Dr.) C. C. Abbott, an American, with whose works his is listed. The publication of additional parts to serve as a subject index are implied in the Introduction and will be eagerly awaited, for they will make at once available the material gathered in this vast compilation of titles. With their appearance Dr. Strong will have produced a guide to literature that will prove indispensable to the serious student of birds and will have rendered a lasting service to the science of ornithology.-G. M. ALLEN.

Dr. Grinnell's 'Bibliography of California Ornithology.'-In two previous installments, the late Dr. Joseph Grinnell has published a bibliography of California ornithology carrying the listing of books and papers up to the end of 1923 ('Pacific Coast Avifauna,' no. 5, 1909; no. 16, 1924). The manuscript for the present or third part,1 taking the bibliography to the end of 1938, was essentially complete at the time of his death in May 1939, and has been finished and put through the press by Dr. Alden H. Miller and Mrs. Grinnell, who have prepared the indexes to authors and bird names included. Several pages include earlier references previously overlooked, but the main portion consists of 200 pages of titles lately added to the voluminous literature on birds of this State. Dr. Grinnell has had a not inconsiderable share in encouraging the preparation and publication of papers on Californian ornithology, so that in more ways than one, the completion of the bibliography is a lasting memorial to his own life work. As was his habit, the listing is done with meticulous care in reproducing titles and references exactly as published, so that, for example, in journals using Roman numerals, the references give these as in the original, or where Arabic numerals are employed as in volume numbers, these are reproduced in the citation. Here one may protest against the practice of using Roman numerals for any except unusual purposes. Long ago, Dr. R. M. Yerkes (Science, n. s., 20: 309-310, 1904) showed by a simple trial, in which ten chosen students wrote the numbers 1-100 in Roman and in Arabic numerals, that it takes three and a third times as long to write the Roman numerals, and the chance of error is twenty-one times as great; while it takes three times as long to read them and the chance of error in so doing, is eight times as great as when using Arabic numerals!

<sup>&</sup>lt;sup>1</sup> Grinnell, Joseph. Bibliography of California Ornithology / third installment / to end of 1938 / Pacific Coast Avifauna, no. 26, pp. 1-235, December 8, 1939; Cooper Ornithological Club. Price \$4.00.

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In issuing this third index to the literature of Californian ornithology, the Cooper Club has provided what is undoubtedly the most thorough listing for any limited area in North America.—G. M. ALLEN.

Forbush and May's 'Natural History of the Birds of Eastern and Central North America.'-The popularity of Forbush's 'Birds of Massachusetts and other New England States' (1925-29) very soon resulted in exhausting the edition of at least the first volume, so that sets of all three volumes are now difficult to secure. The Directors of the Massachusetts Audubon Society have therefore taken the necessary steps for the publication of this new and abridged edition1 which forms a single volume at a popular price and includes the original colored plates by Fuertes and Major Brooks. Dr. John B. May, who assisted with the publication of the first edition, has undertaken the preparation of the abridgment. By omitting the descriptions of plumages, the paragraphs on measurements, molts, and occurrence in Massachusetts, and by condensing those on ranges, identification marks, and nesting, to the smallest compass, as well as by editing and cutting the main text, he has succeeded in reducing the three volumes to a single one of convenient size. The order of the species as well as the nomenclature have been changed to conform with the last edition of the A. Q. U. 'Check-list.' The 'Introduction' gives a brief account of the history of the work and a sketch of Forbush's life. As if all this were not enough, Dr. May has broadened the scope of the book by the addition of short accounts of over one hundred other species regularly found as breeding birds, migrants, or winter visitors east of the 95th meridian, taking in therefore eastern North America from a little west of the Mississippi River. The many species of casual occurrence in the area are gathered in a nominal list at the back of the volume instead of being accorded a regular place with details of records in the body of the book. Four additional new plates by Roger Peterson are added to illustrate some of the birds now included.

While it is true that the general accounts written by Forbush for the different species in the main part of his text are treated from a sufficiently broad point of view to be widely applicable, nevertheless one does not lose sight of the fact that they were prepared from the standpoint of New England and especially Massachusetts. The result is that the new edition, by the omission of a large amount of local matter, loses much of its particular interest without a corresponding gain in thus stretching it to cover eastern and central North America. It would have been much more valuable if instead we might have had a new edition with Massachusetts conditions brought down to date and some account of the many changes and interesting new points made out in recent years of bird study. Thus there is no indication of the occasional and perhaps regular presence of the Western Grebe on our coast in winter, nothing on the changing status of the Ring-necked Duck, or on the recent expansion of gull and tern colonies, nor any attempt to work in new information such as that now available on the Bicknell's Thrush, while from the general nature of the sketches very little data on migration could be given. As a piece of book-making, the volume is well printed and the proof-reading has been excellently done. On the shelf beside the original volumes, the abridgment stands a little higher, since the explanations of each plate, instead of occupying a facing page, are given an extra inch of space at the bottom of each, while 25 2

<sup>&</sup>lt;sup>1</sup> Forbush, Edward Howe, and May, John Bichard. Natural History of the Birds of Eastern and Central North America revised and abridged with the addition of more than one hundred species. Large 8vo, xxvi + 554 pp., 97 col. pls., 1939; Houghton Mifflin Co., Boston, Massachusetts. Price \$4.95.

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further expedient to save bulk, the plates are printed on both sides of the leaf. It is a pity, however, that the manufacturers should not have used greater care in weeding out imperfectly registered plates, nor are the four new ones so well printed as the others.

For the purposes of the new edition, Dr. May has done a difficult task with considerable care, and has presented the reading public with an attractive volume of short sketches of eastern birds.-G. M. ALLEN.

Niedrach and Rockwell's 'Birds of Denver.'-The last comprehensive work on Colorado birds was that of Sclater in 1912, and the last local list for Denver was published in 1928. In the years that have since elapsed much new material has accumulated and many groups of birds have been more critically studied by Dr. Alfred M. Bailey and the authors at the Colorado Museum. This new list1 comprises the birds known to occur within a radius of twenty-five miles of Denver and includes also the Denver Mountain Parks System, a short distance farther westward among the foothills of the Rocky Mountains, so that the area embraces an altitudinal range of almost a mile and a half, taking in the various life zones from Transition to Arctic-Alpine.

The introductory matter includes a sketch of the topography and a short account of the plant life of the successive zones with their characteristic birds. In another chapter the ornithological history of Colorado is briefly outlined. In the body of the work, the birds are taken up in the 'Check-list' order, giving for each the English and Latin names, the field marks, a statement of occurrence, and a paragraph of remarks, chiefly records of interest or notes on habits; finally there is an excellent bibliography and a thorough index. The many illustrations are largely from photographs of characteristic western birds and well exhibit the skillful work of Dr. A. M. Bailey and his associate Mr. Niedrach, both of whom have for a number of years cooperated in the careful study of the birds of the State. Including as it does a large number of typically western birds, the book forms an excellent field guide for visitors to this region, as well as a convenient summary of the local avifauna for the many active observers in this center.-G. M. ALLEN.

Tinbergen's 'Behavior of the Snow Bunting in Spring' is an outstanding field study<sup>8</sup> of this bird on its breeding grounds in southern Greenland. The author distinguishes nine successive stages in the progress of the breeding cycle, as follows: (1) the arrival of the males in flocks at a time depending on the weather conditions but averaging about March 21; the complete breeding dress is not attained until about mid-April. (2) The selection of a territory by the males and consequent breaking up of the flocks about a month later. During this stage the males daily spend a great part of the morning on the territory, singing, but often leave for foraging. (3) The arrival of the females in late April or early May. (4) The fourth period begins with the securing of a mate, who is attracted to the male by its song and display on the territory. The female is not yet ready for copulation; there is an increase in territory fighting between neighboring males, and the boundaries of territories undergo some shrinkage. Mated females drive off other females, but there is no intersexual fighting. (5) With the first coition the fifth period commences. The female's oestrus is marked by the carrying of nesting material to a selected site. (6) The female commences to lay eggs, for the nest is now ready. (7) With the

5: 1-95, 2 pls., text-figs., Oct. 1939.

<sup>&</sup>lt;sup>1</sup> Niedrach, Robert J., and Rockwell, Robert B. The / Birds of Denver / and / Mountain Parks. 8vo, (6) + 196 pp., illustr., map; Colorado Mus. Nat. Hist., Popular Series, no. 5, 1939. \$1.25. <sup>3</sup> Tinbergen, N. 'The Behavior of the Snow Bunting in Spring.' Trans. Linn. Soc. New York,

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seventh period the female commences and alone performs incubation, allowing a day to intervene after the last egg is laid. (8) This phase is marked by the hatching of the young and their subsequent care. (9) The last period is marked by the departure of the young from the nest.

In his account of the varying behavior of both parent birds and their relations with neighboring pairs, the author brings out many interesting facts, such as the occurrence of occasional bigamy, change of mates for a second brood where one bird of the original pair is ready for coition before the other. The matter of sex discrimination in this northern species is well analyzed and analogies are drawn with lizards and fish. Discrimination may result from the failure of the female to display—the lizard method; by difference in fighting activity when threatened; or, when both sexes display, by a difference in releasing behavior in the two sexes. Dr. Tinbergen refutes the conclusion reached by Dr. A. A. Allen in the case of Ruffed Grouse that the male does not discriminate sex in copulation, pointing out that the female reveals her sex by her attitude and by remaining still (as a stuffed bird would in the experiments). Finally there is an illuminating discussion of the functions of fighting, territory and song. The author distinguishes as 'advertising song' that performed by the male on its territory for the dual purpose of attracting a mate and warning off rivals.

A glance at the voluminous bibliography reveals that most of the pertinent literature on this new method of approach to the analysis of bird behavior is of very recent date. The older studies of the habits of birds were concerned more with generalities as seen from the observer's standpoint; the modern field study of birds must pay increasing attention to the bird's viewpoint, the real significance of its various actions as deduced from patiently gathered and critically noted observations. The paper is an excellent example of the new ornithology and an outstanding addition to our knowledge of the social behavior of an arctic passerine during the breeding cycle.—G. M. Allen.

McIlhenny's 'Autobiography of an Egret' is a handsome booklet, notable for its many reproductions of photographs of the Snowy Egret (its full name nowhere appears), taken at the author's bird sanctuary in Louisiana. In its narrative a male egret recounts the story of its life from the time it saw the light of day, through the vicissitudes of the nestling period, to its first migration southward to Colombia and subsequent return to the home rookery, its first breeding season and its various doings in succeeding years, ending with a word of gratitude to the man who made the happy sanctuary where it lives. In lengthy conversations and soliloquies, the bird's intimate thoughts and emotions are laid bare and its remarkable knowledge of itself is revealed.

While the 'bedtime-story' method may be excusable in thus providing entertaining reading for children (which was doubtless the author's purpose), it leaves the more mature reader in a state of perplexity as to how far he may believe the essential points of the narrative. A somewhat more serious account of the habits of this interesting bird would have been very welcome. After all, birds are not human beings much as our sympathies would like to interpret their doings in terms of our own thoughts and feelings.—G. M. ALLEN.

<sup>&</sup>lt;sup>2</sup> McIlhenny, E. A. The Autobiography of an Egret. 8vo, vi + 58 pp., illustr.; Hastings House, New York City, 1939. \$2.00.

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Coloeus monedula ibericus of Spain and Portugal; C. m. nigerrimus of Morocco; and C. m. pontocaspicus from Palestine.

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### FIFTY-EIGHTH STATED MEETING OF THE A. O. U.

The Fifty-eighth Stated Meeting of the American Ornithologists' Union will be held in Boston and Cambridge, Massachusetts, beginning Monday, September 9, 1940. The Local Committee after much careful thought has selected an unusually early fall date instead of the customary later one, for a number of reasons. In the first place, in order to take advantage of the low-rate railroad fares that it is expected will again be offered this year in connection with the New York World's Fair, it is necessary to hold the meeting before the middle of October; secondly, it will be possible to obtain the use of Harvard University lecture halls near the Museum of Comparative Zoology prior to the opening of the fall term; third, the committee feels that with the increasing attendance and growing importance of the field trip as a feature of the meetings, the second week in September offers a maximum of abundance and variety of bird life of all kinds, chance of better weather conditions and longer period of daylight. It is further hoped that a September date will permit those planning to attend to take advantage of the normal vacation period.

An exhibit to include both paintings and photographs of birds will be held in conjunction with the meeting, at the New England Museum of Natural History. Prospective exhibitors should communicate with Mr. D. L. Garrison, 234 Berkeley St., Boston, Mass.

Further information as to hotel headquarters and other accommodations, together with attractions and field trips planned, will be announced in the July 'Auk' and in the 'circular of information' to be issued by the Local Committee well in advance of the meeting.

JAMES L. PETERS, Chairman CHARLES F. BATCHELDER

DAVID L. GARRISON

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### REPORT OF THE COMMITTEE ON BIRD PROTECTION, 1939

The report of the Committee to the Fifty-sixth Stated Meeting of the A. O. U. assumed the function of the critic. Commendation expressed by members indicates that this attitude should be continued. In carrying out this desire, however, the present Committee is working under the handicap imposed by resignation of former Chairman William Vogt, whose capabilities contributed so much to the interest and value of last year's comments. In reviewing the status of threatened species and of milestones on the two-way track of bird protection, the 1939 Committee presents the results of its inquiries into the current causes of depletion or maintenance of our bird life.

A number of species continue to be threatened with extermination. Of these the California Condor, Eskimo Curlew, and Ivory-billed Woodpecker are probably most in danger. In spite of publicity and other educational work by numerous national and local organizations, the condor must still be regarded as a threatened species, although its numbers are perhaps greater than indicated by minimum estimates. In cooperation with the University of California, a three-year Audubon Society fellowship has been initiated for study of the species. Under a regulation designed to give special assistance to vanishing species, the Forest Service established a wilderness area in the Los Padres National Forest of southern California in order to afford the most strict privacy for the condors. The large area included in the nesting range is closed to all public ingress. Because of the wideranging propensities of the birds, however, they go beyond the limits of the wilderness areas and may then be killed by poachers.

No additional information on the Eskimo Curlew is available. It is of course quite possible that the bird is extinct. It would seem advisable, however, for the Union to attempt to establish relationships with organizations or persons in Argentina and perhaps other South American republics that might be in a position to make investigations. If curlews were found to be wintering in that country it is possible that through the Argentine national park directors or other means, some steps might be taken to assure better protection. Investigative and contact work on this species would appear to be a proper function of the Committee on Bird Protection.

Individual Ivory-billed Woodpeckers are certainly alive but their number is very low. Organizations in Louisiana are cognizant of the extreme dangers confronting the species and realize that their State is

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the last stronghold of most of the surviving birds. For the past four or five years several groups have been requesting Federal protection for an ivory-bill habitat in northeastern Louisiana. This fine area, a portion of which is known as the Singer Sewing Machine Company tract (mentioned in last year's report of this Committee) is still subject to cutting. The presence of exceptional timber, in itself a necessity for the birds, makes outright acquisition by the Federal Government appear impossible at this time. If anything is to be done it must be accomplished by private means.

Chances for survival of the Whooping Crane are probably only slightly better. Preservation of this species presents an especially difficult problem and adequate information on its needs is still lacking. This species would be a particularly happy choice as a subject for research work. It is inadequately protected on its wintering grounds and more attention should be paid to determination and reservation of these areas in order to prevent encroachment of disturbing visitors. A few Biological Survey refuges are hosts to the Whooping Crane but extension of protected areas is desirable.

The Trumpeter Swan has made a slow but encouraging increase in numbers although it is by no means out of danger. An estimated five hundred of the birds are known to live and nest in British Columbia but their habitat is isolated and difficult of access. From the standpoint of protection this is extremely fortunate although it has prevented the accumulation of exact data regarding numbers and status. In the United States, fifty-one cygnets were reared last season on the Red Rock Lakes Migratory Waterfowl Refuge, where special efforts have been made to secure utmost safety by excluding all visitors from nursery areas during the spring and summer. The discouragingly low number of only four cygnets was brought to maturity in Yellowstone National Park. Protection in the park was adequate and investigation indicated that predatory animals were not responsible for the poor showing. It is possible that disturbance by human beings may have broken up nestings. Special attention should be paid to insure privacy for the birds during incubation and early part of the rearing season. A number of swans (thirty-nine) have been discovered on small lakes south of Yellowstone National Park. Attention of the Forest Service has been directed to their presence and special protection is promised. A coordinated winter census made about the middle of February 1939, by the Biological Survey and the National Park Service gave a total of sixty-six birds at Red Rock Lakes and

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106 in Yellowstone National Park. The actual count of 172 Trumpeter Swans is believed to represent a population of about 190. This total may have been augmented by migrants from British Columbia that have since returned to the deeper wilderness. Because present information indicates that winter losses of adult swans are largely due to starvation, investigation might disclose feasible means of furnishing natural or artificial aids at that season.

Less than seven hundred Great White Herons are alive today but the future of the species is more secure since establishment of its chief nesting ground in southern Florida as a Biological Survey wildlife refuge. In January 1939, in an aërial survey of the entire range, 585 birds were counted. Since the highest previous count was 426 birds, it seems reasonable to believe that in time the Great White Heron may again become fairly common in the Florida Keys.

Another bird greatly reduced in numbers is the White-crowned Pigeon. It has been killed in large numbers for food and much of its forest habitat has been cut. We have no information on its present status but some encouragement may be derived from the fact that its United States range in the Florida Keys now has complete protection.

During the past year or two, through special efforts of the Forest Service in cooperation with State and Mexican Governments, Masked Bob-whites were reintroduced into Arizona. Up-to-date information on their survival is lacking.

Due to drainage, drouth and fires, which will be described more fully below, the Everglade Kite faces an immediate future that is indeed dark. Information at hand indicates that a very large percentage of the snails on which it feeds has been destroyed. Kites have become extremely scarce in their usual range. Limpkins, largely dependent on the same food supply, are almost equally adversely affected. A few Limpkins and Swallow-tailed Kites find shelter and probably nest on Biological Survey refuges in the southeast.

In Texas, the Roseate Spoonbill is rather favorably situated. It occurs today on several refuges of the Audubon Society and of the Biological Survey, particularly the Aransas Pass Migratory Waterfowl Refuge. The species also occupies sanctuaries on the Louisiana and Florida Gulf Coasts where it receives complete protection. Flocks numbering as high as forty birds have been seen on the Indian Key Refuge of the Biological Survey. On the peninsula of Florida, however, numbers of Spoonbills are very low due in part to drainage and consequent alteration of the environment. Out of the 250 individual

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birds now estimated to be in the southern part of the State, there were but twenty-five breeding pairs during the past spring. Only one rookery functioned, that on Bottlepoint Key in Florida Bay. The future of the Roseate Spoonbill in Florida is very precarious.

The Florida Sandhill Crane has been hard hit by the drouth and the flocks have apparently scattered widely. Protection from wanton shooting is now a greater problem than previously when definite areas were regularly occupied by the birds and were known and patrolled by State, Federal, and Audubon Society wardens. On the other hand, Biological Survey personnel on refuges in the Middle West report that the flight of Western Sandhill Cranes through that section of the country last fall was the largest in years.

It must not be forgotten that the shrinkage in continental status of rare species is only one part of the problem of conserving the American fauna. The other part is the shrinkage in local status of species that may be common elsewhere. Local extirpations make a species almost as inaccessible to the local human population as if the species had disappeared altogether. Moreover, continental extirpations are invariably the cumulative result of many local shrinkages. For example, the Great Blue Heron is presumably still common continentally, but it is becoming decidedly uncommon in some northcentral States, probably because of the destruction of rookeries by fishermen.

The Duck Hawk is dwindling in some localities, probably because of inroads made by egg collectors and falconers.

The Prairie Chicken, which in the Lake States built up to a high level during the cyclic high of 1936, is not recovering with the other grouse. The reason may lie in the wholesale burning of peat meadows during recent drouths, and their subsequent smothering under thickets of non-habitable aspen and poplar. The Sage Grouse has completely disappeared from many districts in the West. The Spruce Grouse is retiring across the Canadian border, presumably because of intensive pulpwood cuttings and the construction of fire trails by the CCC. The Ruffed Grouse, Pileated Woodpecker, and other woods-loving species are steadily being forced out of the regions of intensive agriculture of the Upper Mississippi basin.

The total shortening of local faunal lists by these local shrinkages is probably more important, socially speaking, than the total shortening of continental lists. Under our existing patterns of thought, people do not become alarmed about local faunal losses. "The

species still persists elsewhere." This, however, is the same kind of logic as led to the extermination of the Passenger Pigeon. There is little danger, of course, that many species will repeat the pigeon tragedy, but there is perhaps cause for alarm in the fact that people still think in terms of the same ecological fallacies as prevailed in 1870.

"Extermination" campaigns continue popular. With the demand for predator control running higher in Alaska, outbursts against the eagle have been particularly violent. Crow and other bird-predator control campaigns continue almost unabated. The Biological Survey has made investigations of crow damage particularly in the Plains States and has in nearly all cases found local estimates to be exaggerated. The Survey is attempting as best it can to develop deterrent measures in order to cut down as much as possible actual killing of crows. Under present disorganized methods, crow control does not appear to be seriously affecting the total population. It is suggested, however, that ornithologists should pay more attention to studies of the possible effects of widespread destruction in order to attempt to forecast the ultimate results if these campaigns continue.

Unreasoning war against hawks, which seldom discriminates between beneficial and detrimental species, continues in many parts of the country. It is all too common to read in the daily newspapers the monotonously uniform formula, "The hunters' club of - has placed a 15c per pair bounty on hawks' feet. Club officials said the move was to protect wildlife." In British Columbia the Allied Game Protective Association passed a resolution requesting the provincial Game Commission to remove legal protection from the Red-tailed Hawk, Marsh Hawk, and Prairie Falcon. Your committee has made a small contribution to the defense of hawks by bringing certain biological facts to the attention of the writer of a nationally syndicated newspaper column, which at numerous times in the past several years has printed unreasonable and bitter attacks on 'predatory' species, including the Bald Eagle and the Red-tailed Hawk. No repetition of this type of release has occurred in the six months that have elapsed since the facts were brought to the columnist's attention.

A number of developments during the past year have resulted in unfavorable conditions for birds. Marsh drainage for mosquito control has been extensive and the damage far in excess of what it should be. (Too much of the control is still based on the desire to provide labor for unemployment relief rather than upon clearly demonstrated public need.) During the past five years enough ditches for mosquito

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control have been dug in the United States to circle the earth more than three times at the equator. During the past calendar year approved Federal projects for mosquito-control drainage totaled more than \$40,000,000 in addition to \$25,000,000 for agricultural drainage. Although the enormous damage to bird habitats is to be deplored, some of this eventually may be rectified by natural forces for there is little or no likelihood that more than a small percentage of the projects can be adequately maintained. Since October 1, 1938, when the CCC was withdrawn from mosquito-control operations, there has been a notable lessening of this work along the Atlantic seaboard and the type of control continued is much less damaging. During the past year, as a result of public awakening to the realization of wildlife values and perhaps also due to criticisms of excessive or unwise control measures, many State drainage budgets have been greatly reduced. Since authority for review of WPA projects was given the Biological Survey, damage done by continuing projects has decreased. While the value of some mosquito control is recognized, the public should demand that this work be based on clearly proved need. Furthermore, biological and natural means of control should be employed to the fullest possible extent.

Proposed flood-control measures may also hold possibilities of permanent detriment to bird habitats. Very extensive operations have been proposed in central Florida and it is hoped that the appalling lessons taught by the recent spectacular fires may be kept in mind by those in charge. Information from War Department engineers indicates that appreciation of biological problems involved in flood-control operations is becoming more widely recognized. That organization is now striving to conserve rather than dissipate the water supply of Florida. It is certainly to be hoped that this enlightened attitude will continue.

In connection with a review of past and planned operations designed to 'improve' man's environment, frequently to the tremendous detriment of wildlife factors, we quote W. L. McAtee in Circular 520 of the U. S. Department of Agriculture:

"That wildlife enjoys living in general as much as man, and probably in many ways even more, is a thought that should never be entirely out of mind. Man assumes dominion over wildlife and exercises it as he can, but in so doing he should as far as possible in the case of every creature, respect its right to existence, to its chosen home, and to undisturbed enjoyment of its way of

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life. As has been so often, but not too often, said, in following out ideas for readjusting wildlife and its environment, man should do only what is necessary and no more."

Probably the most outstanding recent misfortune to North American bird life is the great drouth and series of fires in Florida during the past spring. It cannot be denied that the detrimental effects of this drouth, the worst recorded in Florida, were greatly augmented by unwise drainage. The fires burned mainly to the eastward of a northsouth line from Lake Okeechobee to Cape Sable. Something over 2,000,000 acres were burned, often to bed rock, dissipating in smoke and ashes the organic matter in the soil as well as all vegetation. Observers who have traveled extensively over this burned area found few waterholes remaining. Upon examining several Seminole Indian wells, three to four feet deep, they found powdery dust at the bottom. All wildlife-reptiles, amphibians, and mammals particularly-suffered severely. In certain cases the results of the fires have indirectly affected birds. Numbers of raccoons, for instance, concentrated around the remaining water where natural food inevitably became scarce. One large Wood Ibis rookery lost about 60 per cent of the hatched young through depredations by the hard-pressed 'coons. It is improbable that many birds were actually destroyed in the fires but the effects on nesting possibilities were catastrophic. There were no rookeries this spring over great areas on which many egrets, herons, and ibises have been reared in previous years. The colony of about 40,000 White Ibises at Lake Washington dispersed without nesting. The White Ibis has virtually disappeared from Florida instead of being, as formerly, the most abundant breeding species.

Immediate steps should be taken by the State and the Federal Government to remedy as far as possible the destruction caused by unjustifiable drainage in southern Florida which directly contributed to the present situation. If water can be restored, the effects of the fires outside the burned areas will not be felt greatly south of the Tamiami Trail and along the southwestern coast. Due to the destruction of a great portion of the eastern Everglades, it is imperative that a plan be evolved for restoring moisture to the remainder in order to minimize the effects of future fires. This objective could be accomplished if the canals and drainage ditches in the Cape Sable region were blocked off or closed. Gates at the outlets would cause the water to remain on the flat prairies north of Flamingo and East Cape and provide fine winter feeding grounds for all marsh-loving

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birds. Control of water could be achieved by means of gates. It is imperative, however, to devise safeguards for legitimate agricultural interests. Provided this necessary protection can be accomplished, the remainder of the expense involved will be comparatively small.

The Santee-Cooper Rivers diversion project has been much criticised during recent months. It is apparent that local interests are at last awake to the tremendous damage that will result to the environment and to wildlife, especially ducks and geese. Whether national awakening will be sufficiently prompt to prevent consummation of this highly questionable work remains to be seen. At present some preliminary construction work is going forward but great obstacles have been encountered, first in finding suitable footings for the dams and then in securing the necessary lands. If this project is carried through to completion there is little doubt that it will mean a tremendous loss of natural values in fisheries resources and in one of the largest remaining natural swamp areas in the southeast.

For a time it appeared that a much-opposed measure, the Florida ship canal, would receive appropriations for continued construction. Conservationists have been greatly concerned because digging of the canal would wreak tremendous destruction and disturbance of habitats in the region, where numerous comparatively rare species are found. It is also charged that construction would allow salt water to enter from the ocean with tremendous and widespread detriment to the freshwater supplies and to dependent plants and animals. Although appropriation of funds was refused, proponents of the canal insist that they will continue to press for reversal of this action and ornithologists should remain on guard.

Although actual construction of the long-discussed Nicaraguan ship canal appears rather remote, we believe that study should be made in advance so that, if the plan is consummated, attention can be given to saving as much as possible of any essential wildlife habitats that may be present. Even the very resources that may be affected by construction of such a canal are not known and require investigation.

Another measure for canal construction still in the preliminary stages of discussion concerns a projected waterway along the Gulf Coast inside the barrier islands from the Rio Grande to the Sabine River in Louisiana. If this project becomes an actuality, as seems probable, it will, at least to a degree, threaten the best goose and Redhead area in the United States, as well as the habitat of numerous other waterbirds, including some of the best Audubon Society and Biological Survey refuges.

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In spite of repeated professions of respect for wildlife and its habitats, actions of the Tennessee Valley Authority during the past two years have not been in line with good conservation efforts. policy of the Authority has apparently been to sterilize completely all habitats of mosquitoes in the enormous area under its control. This has been carried out thoroughly whether human beings were living near the areas treated or not, and regardless of economic factors and probable consequences to the flora and desirable members of the fauna. Enormous quantities of lead arsenate have been sprayed from airplanes over the waters of reservoirs and samples of mud have shown an arsenic content of as high as 3,330 parts per million. Such an enormous amount of poison will, of course, be a potential danger for a long time to come. Whether the TVA administration will accept the advice of other agencies for a revision of methods of mosquito control remains to be seen. Another disturbing development in TVA policy during the past year has been a radical change in the Authority's outlook on agricultural matters. Dr. Walter B. Jones, Director of the Alabama Department of Conservation, sums this up as follows:

"The Tennessee Valley Authority owns certain lands immediately adjacent to their reservoirs. Until this year the Authority had planted those lands with cover crops and forest trees and in general practiced soil building. Now much of that area is being planted to row crops, and some fields have actually been plowed at right angles to the contours and the soil turned over to the waterline of reservoirs. Soil erosion is resulting. All back water is now muddy. Food and cover for wildlife have been diminished through these practices. It appears that the Authority has completely 'about-faced' in its soil conservation methods."

Adjustment in the relationships of various bird species must continue to extend westward as the Starling spreads toward the Pacific Coast. This exotic bird has recently been collected in Utah and has been seen even in southern Nevada. In the Northwest we believe it had reached the vicinity of Livingston, Montana, more than a year ago.

There are many bright spots, however, in the situation confronting the bird life of this continent. A number of agencies, Federal, State, and private, have continued good work through their various law-enforcement agencies. We are confident that Federal forces have never worked more successfully and with more public support than during the past year. State law enforcement universally is on a higher plane than ever and this has been brought about largely by an awaken-

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ing of the public to the value of wildlife resources. Federal law-enforcement agencies have enjoyed more effective and whole-hearted cooperation of the States than at any time in the past. Protection on Federal reclamations withdrawals in the far West, which previously left much to be desired, has greatly improved and now has a commendable degree of efficiency.

A bill recently adopted by the Territorial Legislature of Hawaii gives complete protection to migratory and native shorebirds for a two-year period and paves the way for extension of the Migratory Bird Treaty Act to the islands. Most of the native birds, including the Nene or Hawaiian Goose, and species introduced during the past ten years were already protected.

A consciousness of the need for protecting the Bald Eagle has been awakened by legislation now pending in both Houses of Congress. It is to be hoped that the measure will soon be adopted to end the senseless slaughter of these magnificent and generally harmless birds. Support of all ornithologists is urged for bills S. 1494 and H. R. 3744.

As counteraction to the many projects that are decreasing the value of bird environment, much work aimed at restoration is being carried on throughout the country. One of the agencies so engaged is the Soil Conservation Service, which, because it has until recently administered no refuge areas, ordinarily receives little credit for bird protection. Although the principal objective is control and prevention of erosion resulting from unwise land use, a corps of trained biologists is employed to accomplish wildlife-habitat improvement and reconstruction through the use of erosion-control plantings especially chosen for their food and cover value. This work is carried on in 834 different areas in 47 States in close cooperation with approximately 72,000 farmers and ranchers. While less tangible than the planting of trees, shrubs, grasses, and legumes, the educational work of the Service in bringing about better appreciation of wildlife on the part of those who control the land may, in the long run, count even more for bird protection than actual physical operations.

While this committee does not wish arbitrarily to single out agencies for special mention from among the many accomplishing excellent educational results, we wish to commend two comparative newcomers to the field. The National Wildlife Federation seeks to coordinate the activities of eleven million sportsmen and the 36,000 groups and clubs engaged in conservation work. As a part of its educational function, the Federation sponsors National Wildlife Restoration Week, during which the story of wildlife conservation was related last

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year in 70,000 school rooms. The sheet of stamps published annually includes bird subjects. The Federation also prepared the bill now known as the Pittman-Robertson Act, which earmarks funds for restoration of wildlife, including gamebirds.

Weekly conservation broadcasts, concerned with non-game as well as game species, have been continued by the American Wildlife Institute, which has also followed up its support of the ten Cooperative Wildlife Research Stations. Funds have been disbursed to aid constituted Federal law-enforcement agencies when regular allotments have been insufficient.

A third but old established organization, the National Association of Audubon Societies, has continued its work with children through its Junior Audubon Clubs. With another summer's operation of the nature camp, it has enrolled 612 teachers and other adult leaders from thirty-two States and three Canadian provinces and provided them with programs for use in their home communities.

Recent reports of the occurrence of the Reddish Egret on the Florida Keys are encouraging. The species has been practically if not entirely extirpated from Florida for a number of years, although it was once numerous.

It is a pleasure to report a small but substantial increase in the numbers of ducks, despite continuance of a gunning season that many consider unreasonably long. It must be remembered, however, that last season was an unusually favorable one, and yet the duck population shows only a moderate gain. It is still believed by many that more stringent measures should be adopted to insure the return of greater numbers of ducks to the northern nesting grounds. Recent investigation indicates that Redheads and Canvas-backs have made satisfactory progress, although they still deserve special attention.

The Atlantic Brant has made a gratifying increase but continued food shortage still restricts its numbers. Eelgrass along the United States coast is in some places in better condition than for several years but as a whole it is still far below normal.

Excellent progress has been made in reserving and placing under protection areas important for the welfare of birds. The White Heron refuge in Florida Bay has been established and personnel installed. A very excellent area, the Aransas Migratory Waterfowl Refuge on the Texas Coast, was staffed at about the time of the last A. O. U. meeting. With nearby Audubon Society refuges, it attracts several species of birds rapidly becoming rare. Among these are the Whooping Crane, Roseate Spoonbill, Reddish Egret, White-tailed Kite, Audubon's

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Caracara, Wild Turkey, and Long-billed Curlew. Numerous other areas have been added to the Biological Survey refuge system but because of shortage of funds have not yet been given adequate protection. Extension of Glacier Bay National Monument by a million acres has provided added sanctuary to sub-arctic shore- and waterbirds. Twelve island areas in coastal Texas, over which no legal protection had previously been exercised, were leased and patrolled by the National Association of Audubon Societies. These areas are important for the conservation of a variety of rare or vanishing species. The Association also was instrumental in securing the establishment, by the State of Florida, of five important bird-nesting sanctuaries in that State. These are administered by the Audubon Societies.

Mention should be added of special measures taken to assist nesting Sooty and Noddy Terns at Fort Jefferson National Monument on the Dry Tortugas, which has been staffed for only a year or two. Norway rats, after escaping from ships, increased to such an extent as to be a menace to the continuation of the colony. Trapping has apparently eliminated these destructive mammals but precautions are necessary in order to prevent further incursions.

It is well to report the acquisition by the Biological Survey of the Back Bay and Pea Island Refuges adjacent to Back Bay and Pamlico Sound as these and the adjacent Mattamuskeet Refuge harbor one of the greatest concentrations of Canada and Snow Geese, Whistling Swans, and ducks known in eastern North America. Sporting and fishing interests demanded changes in the operation of the saltwater guard locks in the Virginia section of the intercoastal waterway that would have tremendously decreased the biological value of the Back Bay area by allowing salt water to enter unrestrictedly. These changes would also have resulted in great detriment to the oyster, crab, and other fish resources. After the probable results were demonstrated, lock operation was allowed to continue as previously. Some progress appears to have been made in acquiring the Cape Hatteras National Seashore area which will also aid in protecting large eastern portions of Pamlico and Currituck Sounds. The future of bird protection in this area looks doubly favorable.

With all the excellent work that has been done to insure survival of bird species and for adequate populations, much remains to be done. The most spectacular form of loss in wildlife is that of botulism in waterfowl and shorebirds prevalent on western lake shorelines. Notable progress has been made by Government agencies in obtaining an understanding of the cause and nature of this disease, as well as in

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al e. in oin devising partial control measures. Further research is under way, which it is hoped will yield information that will largely prevent or more promptly and effectively curb the tremendous losses. Recent studies of the blood of wild birds has shown the frequent presence of protozoan parasites similar to the malarial organism. These have proved to be definitely pathogenic when transferred to birds of economic importance, such as quail. More general studies have been made by technicians of various Services of Sage Grouse, ptarmigan, quail, and Wild Turkey environments with a view to recommending necessary protective measures to insure preservation and increase of these birds. The range of various kinds of desert quail has been extended by installing water developments in California national forests, and food and environmental studies of quail were inaugurated in eastern and western forests.

This Committee wishes to reiterate the hope, expressed in last year's report, that every A. O. U. member will take an active interest in bird and other wildlife conservation. In addition, it desires especially to recommend for attention and action the following: urge State and Federal aid for the Ivory-billed Woodpecker through acquisition in Louisiana of its last important habitat; press for State and Federal action to protect the unique bird fauna of southern Florida through restoration and conservation of its habitat; acquaint the parties concerned, with the inordinate dangers inherent to bird life through construction of the proposed Florida ship canal, the Gulf intercoastal waterway, and the Santee-Cooper Rivers diversion and impoundment project; condemnation of irresponsible control of predacious birds, especially by means of poison; condemnation of excessive and unnecessary drainage carried out primarily in the name of mosquito control.

VICTOR H. CAHALANE, Chairman Aldo Leopold

an WILLIAM L. FINLEY
CLARENCE COTTAM
Committee on Bird Protection

### CONSERVATION NOTES

#### EDITED BY FRANCIS H. ALLEN

THE present picture of the Roseate Spoonbill's condition and prospects in Florida is not quite so rosy as that of last autumn. The Executive Director of the National Association of Audubon Societies tells us in the January-February number of 'Bird-Lore' of a heavy falling-off in the counts of that species. The wardens are making a thorough investigation to determine, if possible, the causes—whether they lie in the birds themselves or in their environment—and they are making a special study of the Spoonbill's food habits. The species appears to be still doing well in Texas. The White Ibis, too, is flourishing in Texas, unusual numbers having been found in the lower Rio Grande Valley. High water in the Everglades and in the Florida prairie country promises a good breeding season for the birds there. The Blue Geese and Lesser Snow Geese wintered in very good numbers on the Louisiana coast and showed an exceptionally large proportion of young to old birds.

Dr. Pearson has met with hearty cooperation from ornithologists and officials in the South American countries and reports the organization of branches of the International Committee in Brazil and Paraguay.

The Biological Survey reports that the wild-life refuges under its charge now number 266, covering in the aggregate more than 13,500,000 acres of land and water. Sixteen of these, with some 4,000,000 acres, are in Alaska, Hawaii, and Puerto Rico. Of the total number, 144 are primarily for waterfowl, 63 for other migratory birds, 29 for non-game birds, and 18 for wildlife in general, while 12 are big-game sanctuaries. The refuges in the Northwest are becoming increasingly important as nesting areas. In 1939 there were some four thousand nests in the Bear River Refuge in Utah, and about 1600 geese are believed to have been raised there. The total waterfowl population there in the fall was estimated at 2,000,000. The Lower Souris Refuge in North Dakota is increasing in productiveness rapidly. It produced 2000 ducks in 1935, 40,000 in 1938, and 100,000 in 1939, according to estimates of the Survey. Cape Romain Refuge in South Carolina is a good nesting ground as well as an excellent wintering area. About 150 Brown Pelicans were raised there in 1939.

A FIVE-YEAR period of research in wildlife management conducted jointly by the Biological Survey, the American Wildlife Institute, and ten State game and conservation organizations terminates this year, and the parties have agreed to renew the coöperation for another five years. The States taking part are Alabama, Iowa, Maine, Missouri, Ohio, Oregon, Pennsylvania, Texas, Utah, and Virginia.

THE Wildlife Division of the National Park Service has been transferred to the Biological Survey.

THE United States Coast Guard has been charged with the duty of assisting the Biological Survey in the enforcement of the migratory-bird laws and regulations. In Massachusetts the State Audubon Society has arranged to give members of the Coast Guard instruction in the identification of the birds that migrate coastwise, especially the ducks. The officers of the Coast Guard are coöperating cordially.

On March 1, an important conservation measure passed the national House of Representatives. This was the revised Barkley Bill giving the Public Health Service control over the discharge of sewage and industrial waste "into the navigable waters of the United States and streams tributary thereto." It may have become law before this number of 'The Auk' is distributed. Though it will not do away with pollution immediately, it does provide a beginning for the work of cleaning up our streams.

# THE AUK

# A Quarterly Journal of Ornithology ORGAN OF THE AMERICAN ORNITHOLOGISTS' UNION

Manuscripts should be typewritten if possible. As an aid in bibliography, titles should be brief. References to literature, if few, may be inserted in parenthesis at the appropriate places in the text, or listed at the end of the paper rather than in footnotes. Roman numerals and extensive tables are to be avoided. Line drawings intended for text illustrations should be in India ink; half-tones cannot be printed in the text since the paper is unsuitable. Longer articles should have a brief summary at the end. Except on request, no proofs of 'General Notes' or short communications will be submitted to authors.

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All articles and communications intended for publication and all books and publications intended for review should be sent to the Editor,

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Subscriptions, requests for back numbers of 'The Auk,' as well as for other publications of the Union, changes of address and remittances should be sent to the Treasurer and Business Manager,

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## THE AMERICAN ORNITHOLOGISTS' UNION

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A recent survey of the stock of back numbers of "The Auk" available from the Treasurer's Office has been made with the result that the status of certain hitherto rare or unobtainable issues is considerably changed. The Council, at the Annual Meeting in Berkeley, authorized the present scale of prices which supersedes all others published, as of October 1, 1989. Orders will be filled in the order in which they are received. Attention is called to the discounts granted on orders of more than five volumes.

Year	Volumes	*Single Copies \$1.00 each	Year	Volumes	*Single Copies \$1.00 each	Year	Volumes	*Single Copies \$1.00 each
1884	\$20.00	None	1901	84.00	All	1919	\$3.00	All
1885	None	Jan.	1902	\$3.00	All	1920	\$3.00	All
1886	None	Jan., Apr., July	1903	\$3.00	All	1921	\$3.00	All
1887	84.00	All	1904	\$3.00	All	1922	\$2.00	All
1888	\$30.00	Apr., July	1905	83.00	All	1923	\$2.00	All
1889	\$20.00	None	1906	\$4.00	All	1924	\$4.00	All
1890	\$20.00	Jan., Apr., July	1907	84.00	All	1925	82.00	All
1891	\$4.00	All	1908	\$4.00	All	1926	\$2.00	All
1892	\$20.00	Apr., July	1909	\$3.00	All	1927	\$2.00	All
1893	84.00	All	1910	\$4.00	All	1928	84.00	All
1894	84.00	All	1911	\$20.00	Jan., Apr., Oct.	1929	84.00	All
1895	84.00	All	1912	83.00	All	1930	87.50	Apr., July, Oct.
1896	\$3.00	All	1913	\$2.00	All	1931	\$2.00	All
1897	\$3.00	All	1914	\$2.00	All	1932	\$2.00	All
1898	\$4.00	All	1915	\$2.00	All	1933	\$2.00	All
1899	\$3.00	All	1916	\$2.00	All	1934	84.00	All
1900	\$3.00	All	1917	\$2.00	All	1935	84.00	All
	VET-		1918	\$2.00	All			

<sup>\*</sup> Note:—In some cases a complete volume is available although a certain issue of that volume cannot be sold separately.

Discounts are granted as follows:

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XVII, 1876-1900, unbound \$3.25 Auk, XVIII-XXVII, 1901-1910, unbound, paper. \$2.00	Zoological Record, Section on Aves: 1922, 1923, 1924 @
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